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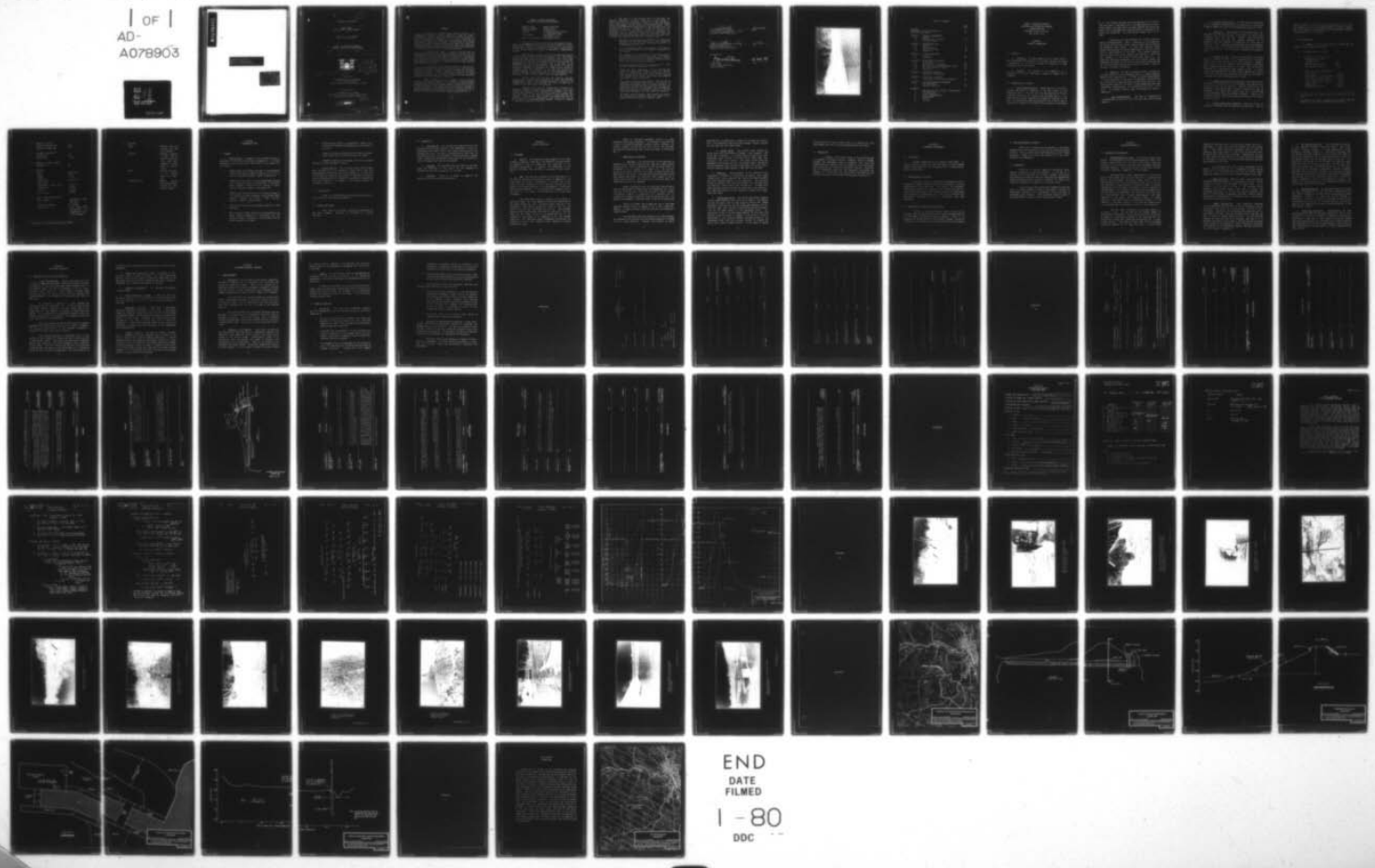

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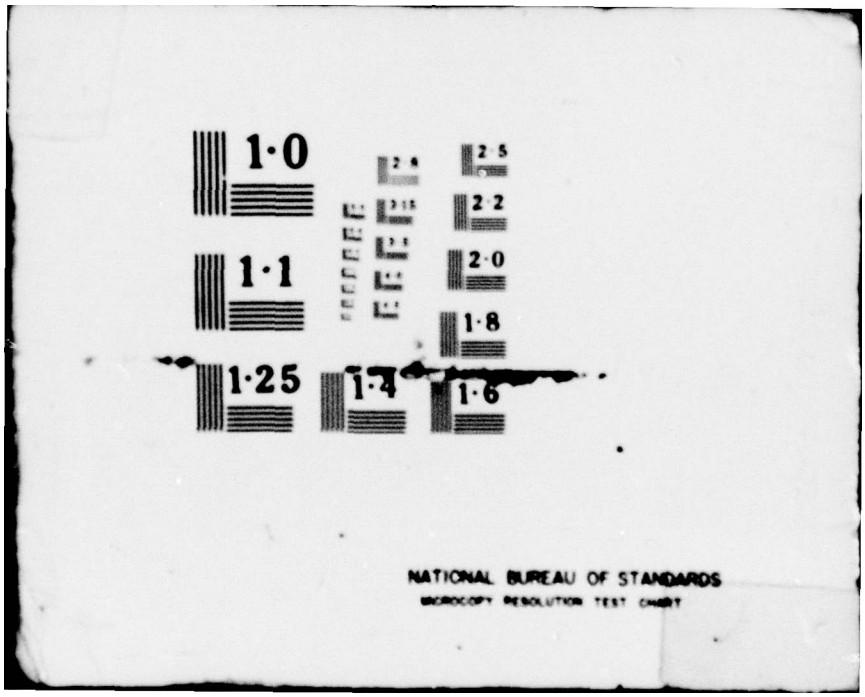
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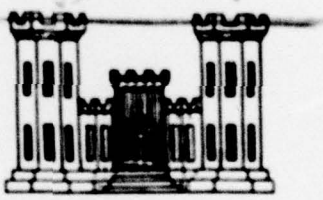
DELAWARE RIVER BASIN

National Dam Inspection Program.

CADJAW DAM.
WAYNE COUNTY, PENNSYLVANIA

NDS I.D. NO. PA 00168
DER I.D. NO. 64-10

(6) PHASE I INSPECTION REPORT.
NATIONAL DAM INSPECTION PROGRAM.
Cadjaw Dam, NDS I.D. Number PA-00168,
DER I.D. Number 64-10. Delaware River Basin,
Wayne County, Pennsylvania.



(15) DACW31-79-C-0017

Prepared by:

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Submitted to:

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams for Phase I Investigations. Copies of these guidelines may be obtained from the Office of the Chief of Engineers, Washington, D. C., 20314. The purpose of a Phase I investigation is to expeditiously identify those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify the need for more detailed studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected, and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam:	Cadjaw Pond Dam
County Located:	Wayne County
State Located:	Pennsylvania
Stream:	Tributary of West Branch of Lackawaxen River
Coordinates:	Latitude 41° 33.7' Longitude 75° 16.5'
Date of Inspection:	26 October 1978

Cadjaw Pond Dam is owned by the Honesdale Consolidated Water Company and was once used as an emergency water supply source for the city and surrounding area. Currently, the dam has no immediate purpose for the water company except in the extreme event that water is needed as a supplemental source.

The designer of the structure is unknown and records indicate that it was probably constructed in the late 1800s. Since that date there is little evidence that significant maintenance has been performed, and the facility is now judged to be in poor condition with seepage noted flowing through the embankment toe, producing a marshy area at the base of the embankment and further downstream. The slopes are covered with woody vegetation and trees that range up to 8 inches in diameter. The dam is classified as a "High" hazard structure consistent with its potential in the event of failure for property damage and possible loss of life immediately downstream. The dam is also classified as an "Intermediate" size dam based on its 1,229 acre-foot total storage capacity.

Calculations indicate that the existing spillway systems are not adequately designed to pass the Probable Maximum Flood (PMF). The spillway capacity is judged to be "Inadequate" in that the spillways can pass the required 50 percent of the PMF without overtopping.

Although there were no indications of imminent embankment instability, the steep slopes covered with woody vegetation contain evidence of downslope movement, both vertically and laterally. In addition, the 4-foot stone wall near the crest of the dam has failed, moving downward and outward. The seepage noted through the downstream toe and beyond is probably not associated with piping, but can be attributed to through-embankment seepage, foundation seepage or possibly a combination of both.

The dam is in an obvious state of disrepair and severely neglected. Further, there are a large number of unknowns concerning the overall stability of the embankment. Until such time as appropriate studies are made and needed repairs performed, the dam should be considered unsafe. Based on this, the following recommendations are presented with the anticipation that it is desired to keep the structure and reservoir in service. If there is no need to maintain this structure, or if rehabilitative costs are excessive, an alternate solution would be to breach the structure under the guidance of a Professional Engineer, and allow the water level to reach the preexisting level of the natural lake.

1. The pool level should be lowered to at least the elevation of the pond drain until the subsequent measures are taken to place the dam and reservoir in a satisfactory condition.

2. It is recommended that a geotechnical investigation be conducted coupled with a stability analysis of the slopes.

3. The seepage at the downstream toe and beyond should be collected and the rates monitored. Piezometers should also be installed in the embankment to determine the location of the phreatic surface, which would aid in the stability analysis.

4. Spillway systems should be reconstructed to meet current hydrologic/hydraulic criteria.

5. Trees and other vegetation on the upstream and downstream embankment slopes should be removed. Prior to removal, the long term stability of the slope should be evaluated in light of the decaying root systems which could cause additional seepage and possible slope instability.

6. The outlet works and the control tower should be inspected and repaired as necessary. Because of the downstream populated areas, a formal procedure of observation and warning during periods of high precipitation should be developed and implemented. This procedure would include a method of warning downstream residents that high flows are expected.

7. The Owner should develop a maintenance and inspection checklist to insure that all items are inspected and maintained on a regular basis.

John Boschuk, Jr., P.E.
Pennsylvania Registration 27450E
Woodward-Clyde Consultants

Jan 24, 1979
Date

John H. Frederick, Jr.
Maryland Registration 7301
Woodward-Clyde Consultants

1/24/79
Date

APPROVED BY:

16 Feb 79
Date

G. K. WITHERS
Colonel, Corps of Engineers
District Engineer

OVERVIEW
CADJAW DAM, WAYNE COUNTY, PENNSYLVANIA

TABLE OF CONTENTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
CADJAW POND DAM
NATIONAL ID NO. PA 00168
DER ID NO. 64-10

SECTION 1
PROJECT INFORMATION

1.1 General.

a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Cadjaw Dam is a 27 foot high earthen dam across a tributary of the West Branch of the Lackawaxen River. The 380 foot long dam impounds an 89-acre reservoir within an 0.7 square mile drainage basin. Very limited data exists regarding the physical features of the dam. The downstream slope was measured to be 2.05H:1V, and is covered with vegetation and dense trees as shown on Photograph

No. 8. The average upstream slope was measured to be 2.2H:1V from the crest to the water line. The upstream portion of the slope between the crest and to at least several feet below the water line is riprapped with natural stones consisting of red shales and sandstone. The crest width ranges from 8 to 12 feet.

Located at the right abutment is a control house as shown on Photograph Nos. 1 and 2. Contained in this house are two valves which control outlet flows for pond drain discharge and emergency water supply. A 7 foot wide concrete intake channel and spillway is located immediately to the left of the control house adjacent to the dam. This channel supplies water to the control house chambers and ends at a 7 foot long weir adjacent to the control house (see Photo 2). An auxiliary spillway excavated into the natural shales and sandstone is located to the right of the control house and has an 11-foot bottom width and a top width of 34 feet. There is no other information available.

b. Location. The dam is located across a tributary of the West Branch of the Lackawaxen River in Texas Township, Wayne County, Pennsylvania. The dam is located approximately 1.3 miles southeast of the center of Honesdale, Pennsylvania, at an elevation of approximately 300 feet above the city. The dam site and reservoir are shown on USGS Quadrangle entitled, "Honesdale, Pennsylvania", at coordinates N 41° 33.7' W 75° 16.5'. A regional location plan is enclosed as Plate 1, Appendix E.

c. Size Classification. The dam is classified as "Intermediate" by virtue of its 1,229 acre-feet total storage capacity.

d. Hazard Classification. A "High" hazard classification is assigned consistent with the potential for extensive property damage and loss of life downstream along the creek.

e. Ownership. The Honesdale Consolidated Water Company performs dam maintenance and operates the valves which discharge water from the dam. However, over the years, residents along the lake have claimed ownership of the reservoir and the legality of ownership is still open to question. Until ownership is determined, all correspondence should be sent to the Honesdale Consolidated Water Company, Post Office Box 307, 109 7th Street, Honesdale, Pennsylvania 18431.

f. Purpose of Dam. Since the exact date the dam was built is unknown and there is no documentation in available files, the initial purpose of the dam is unknown. However, after the turn of the century, the Honesdale Consolidated Water Company acquired rights to the water, and the reservoir was used as a supplemental water supply source. In recent times, the Honesdale Consolidated Water Company has acquired other means of supplying residents with water and this dam is no longer used as an emergency water source.

g. Design and Construction History. The exact date of construction is unknown but it is believed to be several years before the turn of the century. Sometime around 1914, the Honesdale Consolidated Water Company acquired the dam as reported in a 3 August 1917, "Report Upon the Cadjaw Pond Dam of the Honesdale Consolidated Water Company". There are no available records from which design and construction history can be obtained.

h. Normal Operating Procedures. Reservoir flows are normally discharged over the concrete spillway weir. The two

valves located in the control house are used to either drain the reservoir, or in an extreme emergency situation, supplement water supply to the Honesdale Consolidated Water Company. These valves are rarely opened.

1.3 Pertinent Data.

A summary of pertinent data for Cadjaw Dam and reservoir are presented as follows:

a.	Drainage Area (sq. miles)	0.7
b.	Discharge at Dam Site (cfs)	
	Maximum Known Flood[1] (August 1955)	36
	Maximum Design Flood	400
	Minimum Required Flow	None
c.	Elevations (feet above MSL)[2]	
	Top of Dam	1,321.2
	Spillway Weir Crest (concrete)	1,318.0
	Emergency Spillway (rock)	1,318.3±
	Water Supply Invert (approx.)	1,315.0
	Normal Pool	1,318.0
	Maximum Known Flood	1,318.9

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(1) The reservoir was lowered prior to the start of the storm.

(2) Spillway crest elevation assumed to be 1,318.0 from USGS Quad Sheet. All other elevations are relative.

d.	Reservoir (miles)	
	Length at Normal Pool	0.85
	Fetch at Normal Pool	0.85
e.	Storage (acre-feet)[1]	
	Normal Pool	921
	Top of Dam	1,229
f.	Reservoir Surface (acres)	
	Normal Pool	89
g.	Dam Data	
	Type	Earth fill
	Length	380 ft
	Height	27 ft
	Crest Width	8 to 12 ft
	Side Slopes	
	Upstream (to water level)	2.2H:1V
	Downstream	2.05H:1V
	Cutoff	Unknown
	Grout Curtain	Unknown
h.	Water Supply and Blow-Off	
	Water Supply	Supplemental supply only.
	Blow-Off (diameter)	12 inches
	Description	Terra cotta pipe discharging at embankment toe at right abutment.

(1) Values do not include natural lake volume.

i. Spillway

Type	Concrete weir and natural rock and soil channel.
Location	Concrete channel on left side of control house and rock and soil channel on right side of control house.
Width	7 ft for concrete; 11 ft bottom width for channel.
Discharge Chute	Natural ground just beyond downstream toe near control house.

SECTION 2
ENGINEERING DATA

2.1 Design.

a. Availability. A summary of the engineering data is presented on the checklist attached as Appendix A. Principal documents containing pertinent data used for this report are as follows.

1. "Report Upon the Cadjaw Pond Dam of the Honesdale Consolidated Water Company" prepared by Mr. R. J. Gillis, Assistant Engineer, dated 3 August 1917.

2. "Report Upon the Plans for the Proposed New Spillway at the Cadjaw Pond Dam of the Honesdale Consolidated Water Company" prepared by Mr. George S. Beal, Division Engineer, dated 25 September 1917.

3. "Report Upon the Construction of the New Spillway at the Cadjaw Pond Dam, Honesdale Consolidated Water Company" prepared by George S. Beal, Division Engineer, dated 17 January 1918.

4. Twelve black and white photographs dated 1917, 1962 and 1965.

5. One information sheet dated 1914 as prepared by the Water Supply Commission in connection with the survey of lakes. Contained in this document are the basic features of the dam.

6. Miscellaneous letters, correspondence, memos, mostly directed towards controversies as to ownership of the pond.

7. Inspection reports prepared by the State of Pennsylvania, dated from the 1920s through the 1950s.

Documents regarding the design could not be located and are no longer believed to exist.

b. Design Features. The principal design features have been obtained from the documents listed above and from measurements taken during the field inspection. A plan view of the physical features is presented in Appendix E together with the maximum section obtained by surveying the dam during the field inspection. A summary of the design features is included in Section 1.3.

2.2 Construction.

There is no data available concerning the construction history of this dam and reservoir.

2.3 Operational Data.

Water level and rainfall records are maintained by the water company. Rainfall is recorded at a nearby reservoir.

2.4 Evaluation.

a. Availability. All information presented herein was extracted from records located in the Department of Environmental Resources (DER) files in Harrisburg, Pennsylvania, from conversations with the Owner's representative and from the limited resources of the Honesdale Consolidated Water Company files. Design and construction data could not be located nor could the operational records be located.

b. Adequacy. The available data included in the State files and presented in this report are not adequate to evaluate the engineering aspects of this dam.

c. Validity. There is no reason to question the validity of the limited available data.

SECTION 3
VISUAL INSPECTION

3.1 Findings.

a. General. The observations and comments of the field inspection team are contained in the checklist enclosed herein as Appendix B and are summarized and evaluated in the following subsections. In general, the appearance of the facility indicates that the dam is currently in poor condition.

b. Dam. The vertical alignment (crest deformation) of the dam was checked and a profile is shown in Appendix E. No discernable horizontal displacement or bulging were noted along the crest. However, a 4 foot high wall located near the crest on the downstream side of the dam appears to have moved laterally and downward. It is estimated that movements are on the order of 1 to 2 feet. The end sections of the wall have collapsed.

The downstream slope is irregular with evidence of downslope creep. The slope appears to have been stabilized by the dense vegetative cover, including trees, growing on the embankment. Wet marshy areas were noted at the toe, and within the area just downstream of the toe. Some seepage emergence and flowing water was noted in this area. The flow rates of the seeps could not be determined due to the vegetation; see Sheet 5a of Appendix B for the seepage locations. The upstream riprap (presumably unfiltered) was observed to be in fair condition with vegetation growing between the rocks.

Signs of upstream embankment failure or slope sloughing were readily apparent. No evidence of distress was visible in abutment/embankment junction zones. However, the junction between the dam and the left side of the principal spillway has experienced some erosion as shown on Photograph No. 3.

c. Appurtenant Structures.

1. Spillway. The concrete weir of the spillway is assessed to be in fair condition with some minor spalling and deterioration. This is expected for this structure which is estimated to be in excess of 70 years old. The concrete joints are in poor condition with signs of deterioration and spalling of the joints. The concrete retaining walls along the channel and above the waterline were judged to be in fairly good condition. The condition of the walls below the waterline could not be assessed.

Water discharging over the spillway flows directly onto a rocky surface and down along the embankment toe. Since the rock contains open joints and fractures, there is water infiltration leading to subsurface flow, possibly over or through the foundation materials and out beyond the toe. The exact flow passages of spillway water could not be determined.

There is a wooden foot bridge over the 12 foot deep approach channel which is judged to be in fair condition. However, it does not have a hand railing and is considered a safety hazard.

The emergency spillway located at the right abutment and excavated into natural soil and shales/sandstone is judged to be in good condition. However, the channel is poorly

designed and is essentially a swale cut through the natural rock. The discharge flows along the abutment contact through the rock and into the valley below.

2. Outlet Works. The control tower houses two valves which were exercised and judged to work properly. The valve type is unknown. It is known that the pond drain valve discharges water through a 12-inch terra cotta pipe just outside of the control house. This water flows along the embankment toe running down into the valley below. The second valve discharges water through a pipe down the valley into a holding reservoir approximately 1,000 feet from the dam.

d. Reservoir. Reconnaissance of the reservoir area disclosed no evidence of significant siltation, bank slope instability or other features that would significantly affect the flood storage capacity of the reservoir. The reservoir slopes are moderate and there are several rock outcrops along the reservoir, particularly near the dam site. Cottages with lawns and some trees are along the lower end of the reservoir. The remaining portions of the slope are covered with grass, brush and trees.

e. Downstream Channel. The downstream channel appears to be in good condition with little or no debris. Just beyond the dam the water flows through property owned by Mr. Thomas Kovelesky, discharging along the stream approximately 100 feet from his house, then into the uninhabited valley and discharging into the West Branch of the Lackawaxen River. Mr. Kovelesky's house is located approximately 700 feet below the dam and would be subject to damage in the event of failure. Downstream of the junction between the West Branch of the Lackawaxen River and the tributary itself is located the school and a small shopping center. In the event of abrupt

failure during a severe storm, there is a possibility that some damage may occur to this shopping center and school.

3.2 Evaluation.

In summary, the visual survey of the dam disclosed no evidence of incipient failure. However, signs of seepage through the embankment and/or foundation and long term creep/distortion indicate that the stability of the structure may be marginal and should be evaluated in detail. Since the type of embankment materials and placement techniques are unknown, it is concluded that additional investigations and evaluations should be performed as described in Section 7.

SECTION 4
OPERATION PROCEDURES

4.1 Procedures.

Normal conditions do not require a dam tender. It is not known how often that the pond drain or water supply valve is exercised, but it is believed that it is exercised at least once per year.

4.2 Maintenance of the Dam.

Although the dam is owned by the Honesdale Consolidated Water Company, there is very little evidence of routine maintenance of this structure. For example, the embankment slopes are covered with a dense stand of trees and there is uncontrolled and unmonitored seepage through the embankment toe and beyond the embankment toe. There is no evidence that maintenance procedures, written or otherwise, have been developed.

4.3 Maintenance of Operating Facilities.

Similar to dam maintenance, there is very little evidence that the operating facilities have been maintained by the Honesdale Consolidated Water Company. There is no evidence the valves have been lubricated. However, during the inspection, the valves were exercised and functioned properly.

4.4 Warning Systems in Effect.

There are no formal warning systems or procedures established to be followed during periods of exceedingly heavy rainfall. The only dwellings downstream belong to Mr. Thomas Kovelesky. These are located approximately 700 feet downstream of the embankment.

4.5 Evaluation.

There are no written operating procedures, maintenance procedures or warning systems. If the dam is to continue to be controlled by the water company, maintenance and operating procedures should be developed and implemented. These procedures should include a checklist of items to be observed, operated and inspected on a regular basis.

Since a formal warning procedure apparently does not exist, a formal procedure should be developed to notify the downstream residents, and implemented during periods of extremely heavy rainfall. This procedure should include a detailed method of monitoring the dam and pool levels.

SECTION 5
HYDROLOGY/HYDRAULICS

5.1 Evaluation of Features.

a. Design/Evaluation Data. No original design data exists. The Department of Environmental Resources (DER) files contain reports dated 1917 and 1918, which have a hydraulic evaluation of the original spillway and replacement spillway discharge capacity. Further hydrologic and hydraulic evaluations are contained in Appendix C of this report.

The watershed is small, approximately 1.4 miles long and 0.9 miles wide, having a total area of 0.7 square miles. Within the watershed, elevations range from a high of approximately 1,540 to the estimated normal pool of 1,318. The watershed is approximately 30 percent wooded, 25 percent residential, and the reservoir surface is about 18 percent of the watershed. It is likely that residential development will continue within the watershed. The reservoir is also the site of a pre-existing lake located approximately 1,800 feet upstream of the dam. The approach channel of Cadjaw reservoir's spillway extends a considerable distance into the reservoir. The exact location of the lake and channel could not be determined from available records or the inspection.

The 1917 report evaluated the spillway capacity to be about 71 cfs. As the dam was not judged capable of withstanding overtopping, the State directed that provisions be made for a spillway discharge of not less than 400 cfs. Accordingly, plans were submitted and approved for a trapezoidal channel, 5 feet deep, 20 feet wide, with an estimated discharge capacity of at least 400 cfs. A 1918 State

inspection disclosed that the constructed channel was only 4 feet deep, 18.5 feet wide, and cut through rock and "tough" clay. The normal operating procedure was to keep the reservoir water level about 1.5 feet below the spillway crest, providing more flood control storage. Consequently, as only 12 feet (below the spillway notch) of water would be released in the event of failure, the constructed emergency spillway was accepted by the State.

In accordance with the criteria established by the Federal (OCE) Guidelines, the recommended spillway design flood for this "Intermediate" size dam and "High" hazard potential classification is the Probable Maximum Flood (PMF).

b. Experience Data. Reservoir water level records are maintained and precipitation is recorded at the No. 1 Pond, located 4.5 miles north-northeast of Cadjaw Pond. It is reported that the depth of flow in the spillway during Tropical Storm Diane, August 1955, was 11 inches, and estimated discharge of 6 cfs for the original spillway, and about 30 cfs through the emergency spillway. Weather bureau publications indicate about 6.02 inches of rain in the 24-hour period for this general area.

c. Visual Observations. This inspection disclosed that the emergency spillway control section is smaller than as originally constructed, with a bottom width of about 11 feet. See Plate 2. The height of the spillway wall above the weir is 20 inches at the weir, while at the centerline of the dam, the wall is about 33 inches above the weir. As the spillway channel is 7 feet wide and is not straight, see Plate 4, it is possible that debris would lodge in the spillway during large flows, reducing the discharge. Other observations regarding the condition of the downstream channel, spillway and reservoir are located in Appendix B.

d. Overtopping Potential. The overtopping potential of this dam was estimated using the "HEC-1, Dam Safety Version", computer program. A brief description of the program is included in Appendix C. Calculations indicate that the maximum spillway capacity is 140 cfs when the depth of flow is 20 inches above the concrete spillway weir, which is the maximum height of the spillway wall at the weir. The discharge from the dam is 360 cfs when the reservoir water level is at the top of the spillway wall. At that time, water would be flowing over the downstream portion of the wall. This condition is considered undesirable. The HEC-1 computed peak PMF inflow to be about 2,060 cfs. The spillways can pass the required 50 percent of the PMF storm without overtopping the spillway wall at the embankment centerline. As shown on Plate 5, Appendix E, the dam crest profile is uneven. The elevation of the spillway wall at the embankment centerline is the minimum elevation of the crest.

e. Spillway Adequacy. The spillway system for this dam is rated as "Inadequate" but not "Seriously Inadequate" as it will pass 50 percent of the PMF without overtopping the main embankment. However, the lower end of the spillway is expected to overtop at 50 percent of the PMF; but this is not considered to be critical for a limited duration, as overtopping at this location has probably occurred sometime in the past without incident.

f. Downstream Conditions. Approximately 500 feet downstream of the dam the discharge flows under a public road. A house at this section is subject to damage in the event of dam failure. There are no other homes or buildings located along the channel above its confluence with the West Branch of the Lackawaxen River, which is approximately 1 mile below the dam. Downstream of the confluence is a small shopping center and a school.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. Visual observations did not indicate an immediate embankment stability problem, but there is evidence of long-term downstream slope movements and, in its present state, the dam is considered to be in a non-critical unsafe condition. This evidence includes slope distortions, such as slope bulging and the downward and outward movement of the failed 4-foot high stone wall near the dam crest.

As discussed in Appendix B, clear seepage was observed through the embankment toe. A marshy area coupled with some seepage emergence was also noted beyond the downstream toe. The seepage is probably not associated with piping. It is believed to be associated primarily with flow through the pervious rock foundation and seepage through the lower elevations of the embankment.

Both the upstream and downstream slopes are heavily vegetated with trees which range up to 8 inches in diameter. The eventual deterioration of root systems represents a potential long-term piping failure hazard.

The concrete spillway is considered to be in fair condition, but is subject to clogging by debris during periods of significant runoff. The natural rock spillway is somewhat smaller than reported in the State documents, but is observed to be stable. Both the concrete and natural rock spillways discharge near the base of the downstream toe, discharging along the toe or along the embankment. This configuration is

considered to be undesirable and could lead to erosion of the embankment.

b. Design and Construction Data. No design or construction data is known to exist. All data concerning physical features are limited to physical dimensions of the dam taken during the field inspection and are, therefore, inadequate for a detailed evaluation of the dam.

c. Operating Procedures. No operating procedures currently exist.

d. Post-Construction Changes. Since the last construction change in 1917 consisting of the construction of an auxiliary spillway, there are no major reported changes to this dam.

e. Embankment Stability. There were no embankment stability evaluations located in the files. The visual inspection revealed a dense tree cover on both the downstream and upstream slopes. Normal engineering practice requires the removal of these trees. However, root deterioration after deforestation can lead to piping and loss of stability. Therefore, a downstream weighted slope filter should be installed to insure long-term stability of the embankment after deforestation.

f. Seismic Stability. The dam is located in Seismic Zone 1. Normally it can be considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake conditions. Since the static factor of safety for this dam is unknown, a seismic stability evaluation cannot be made. Considering the condition of the slopes covered with trees and with signs of creep movement, it is concluded that both the static and seismic factors of safety should be evaluated.

SECTION 7
ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment.

a. Evaluation. On the basis of the visual inspection, the dam is judged to be in a generally poor condition and should be considered unsafe. There is no engineering or construction data other than the meager information obtained from the field or from discussions with Honesdale Water Company representatives which serve to impact this judgement.

The downstream and upstream slopes are covered with trees. The downstream slope is irregular, showing the signs of long-term creep. This is evidenced by the retaining wall, which has collapsed near the top of the dam at the maximum section.

The outlet systems are considered "marginal" and the spillway is considered to be "Inadequate" using the Corps of Engineers criteria. There are several zones of seepage through the embankment toe and well beyond the toe, producing a large marshy area. This flow is uncontrolled and unmonitored.

b. Adequacy of Information. Insufficient engineering and construction data was found to adequately evaluate the stability of the dam and service life of the outlet works housed in the control house. Specifically, there is no substantial data delineating the types of material and configuration of the embankment. There is no evidence of an embankment drainage system. Foundation preparation details are also unknown. It is not known if there is a cutoff trench

or a grout curtain. However, it is believed that these two features were not incorporated in the design and construction of the dam.

c. Urgency. It is concluded that the recommendations considered to be critical in Section 7.2 be implemented immediately. All other items should be implemented as soon as practical.

If there is no further use for this structure and if repair costs are excessive, an alternate solution would be to breach the structure under the guidance of a Professional Engineer and reduce the pond to the level of the previously existing natural lake.

7.2 Remedial Measures.

a. Facilities. The following recommended remedial work is considered to be critical and should be performed immediately.

1. The pool level should be lowered to at least the elevation of the pond drain until the following measures are taken, data analyzed and appropriate remedial measures formulated.

2. A geotechnical investigation of the structure and stability analysis of the slopes should be performed. Using this information, a set of "As-Built" drawings should be prepared.

3. The seepage along the downstream toe and beyond the toe of the dam should be collected and the rates of seepage monitored. Coupled with this seepage

evaluation, piezometers should be installed in the embankment to determine the location of the phreatic surface which would aid in the stability analysis.

4. The spillway system should be reconstructed to meet current hydrologic/hydraulic criteria as determined from a detailed hydrologic/hydraulic analysis.

The following items are considered important and should be performed as soon as practical:

1. The trees and other vegetation on the upstream and downstream embankment slopes should be removed. Such removal would facilitate a thorough inspection of the seepage sources. However, the long-term stability of the slopes should be evaluated in light of the decaying root systems, and consideration should be given to providing a filter on the downstream slope to prevent piping.

2. The outlet works in the control tower should be inspected and repaired as necessary.

b. Operation and Maintenance Procedures. Formal maintenance and warning procedures should be developed and implemented for this facility. The warning procedure should include a method of warning downstream residents that high flows are to be expected. If necessary, evacuation procedures should also be developed and implemented as necessary.

The Owner should also develop an inspection checklist as an amendment to the maintenance procedure to insure that all critical items are periodically inspected and maintained.

APPENDIX

A

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM *Cadjaw Dam*

ID # *PA 00168*

ITEM	REMARKS
AS-BUILT DRAWINGS	*None*
REGIONAL VICINITY MAP	*See Plate 1, Appendix E.*
CONSTRUCTION HISTORY	*Very limited data available from DER and Owner.*
TYPICAL SECTIONS OF DAM	*None*
OUTLETS - PLAN	*None*
DETAILS	
CONSTRAINTS	
DISCHARGE RATINGS	*None available*
RAINFALL/RESERVOIR RECORDS	*None available*

ITEM	REMARKS
DESIGN REPORTS	*None*
GEOLOGY REPORTS	*None*
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	*None*
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	*No records.*
POST-CONSTRUCTION SURVEYS OF DAM	*None known.*
BORROW SOURCES	*Unknown*

ITEM	REMARKS
MONITORING SYSTEMS	*None*
MODIFICATIONS	*Unknown*
HIGH POOL RECORDS	*None*
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	*Unknown*
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	*Unknown*
MAINTENANCE OPERATION RECORDS	*None*

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	*None. A field sketch was prepared and is presented in Appendix E.*
OPERATING EQUIPMENT PLANS & DETAILS	*None*
MISCELLANEOUS	1. *12 photographs of the dam and spillway.* 2. *"Report Upon the Construction of a New Spillway", January 17, 1918.*

APPENDIX

B

CHECK LIST
VISUAL INSPECTION
PHASE I

Name Dam *Cadiew Pond Dam* County *Wayne* State *Pennsylvania* National ID # *PA 00168*

Type of Dam *Earth (Assumed)* Hazard Category *I (High)*

Date(s) Inspection *26 Oct. 1978* Weather *Cloudy, Drizzle, Cool* Temperature *40's - 50's*

Pool Elevation at Time of Inspection *1315 ±* M.S.L. Tailwater at Time of Inspection *N/A* M.S.L.

Inspection Personnel:

Mary Beck (Hydrologist)
Ray Lambert (Geologist)
John H. Frederick (25 Oct. 1978)
John Boschuk, Jr. (Geotechnical/Civil)
Vincent McKeever (Hydrologist)

John Boschuk, Jr. Recorder

Remarks:

Mr. George Williams from the Honesdale Consolidated Water Company provided assistance at the office and his assistant exercised the two control valves at the dam's control house.

(1) Since there are no records available, it is assumed that the structure is predominantly earth.

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	*N/A*	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	*N/A*	
DRAINS	*N/A*	
WATER PASSAGES	*N/A*	
FOUNDATION	*N/A*	

CONCRETE/MASONRY DAMS

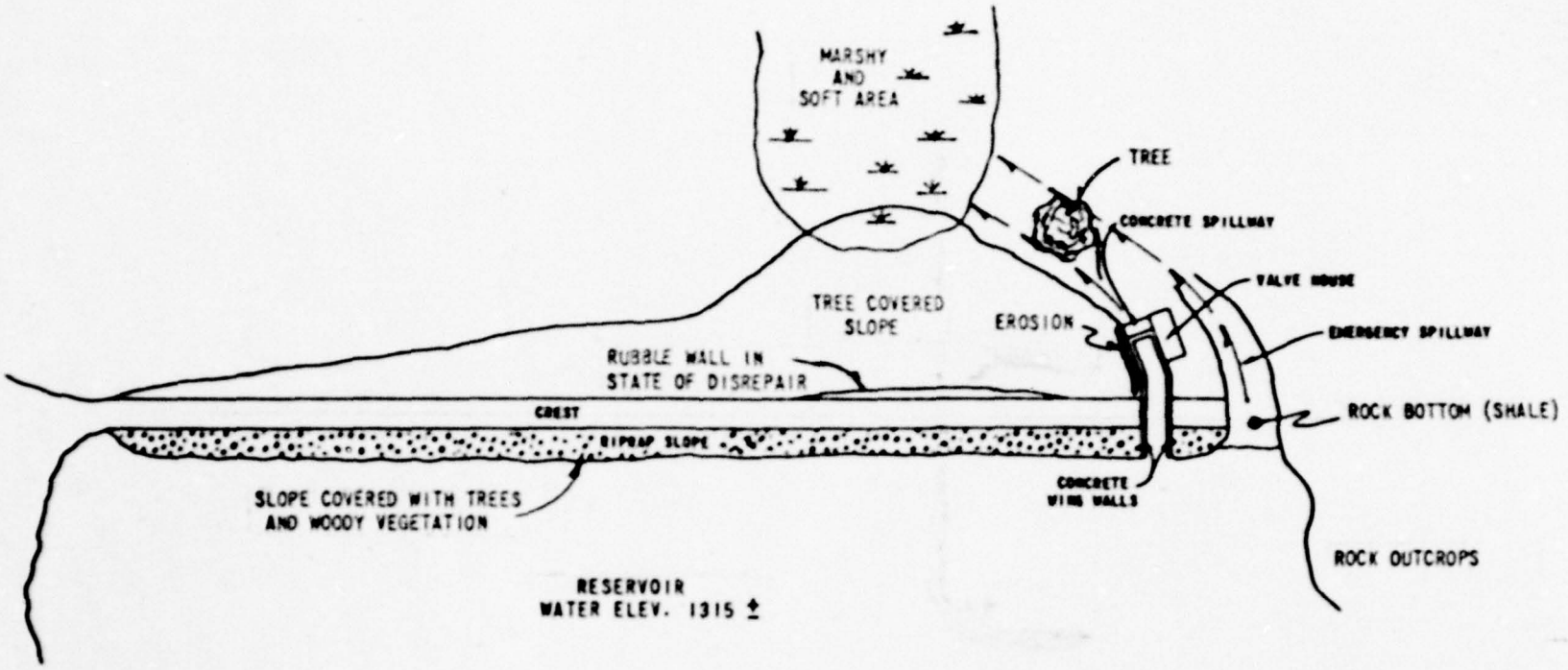
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	*N/A*	
STRUCTURAL CRACKING	*N/A*	
VERTICAL AND HORIZONTAL ALIGNMENT	*N/A*	
MONOLITH JOINTS	*N/A*	
CONSTRUCTION JOINTS	*N/A*	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	*No cracks observed.*	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	*Significant movements may or may not have occurred. There are no drawings to compare design and present conditions. However, as discussed on Sheet 5 the toe and the area beyond the toe are wet and marshy with some flowing water.*	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	*Yes. A four foot high wall located on the downstream side of the crest appears to have moved downstream and downward. It is estimated that movements are on the order of one or two feet. The end sections of the wall have collapsed and no longer function as a wall. The downstream slope is irregular and there is evidence that it has creeped. The slope should be stabilized.*	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	*The vertical alignment of the dam was checked and the profile is shown in Appendix E. The horizontal alignment appears to be good with no significant downstream movements at the crest. However, the downstream wall has moved as discussed above.*	
RIPRAP FAILURES	*The only major rock failure noted was the four foot high wall at the crest of the dam on the downstream side. See discussion above.*	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
EMBANKMENT SLOPES	*As shown in Appendix D, the slopes are covered with trees, vegetation and debris and are in poor condition. The downstream slope varies in inclination. The stability should be evaluated and the slopes should be cleared of vegetation, regraded/stabilized and revegetated with grass.*	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	*These junctions are in fair condition.*	
ANY NOTICEABLE SEEPAGE	*Yes. See Sheet 5a for details. The entire downstream area from just above the dam toe to 50 or more feet downstream is wet and marshy. It appears to be seeping through or under the dam. This condition should be checked and the area stabilized.*	
STAFF GAGE AND RECORDER	*None*	
DRAINS	*Unknown.*	



SEEPAGE LOCATION PLAN
CADJAW DAM

SHEET 5a OF 11

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	*Could not be determined.*	
INTAKE STRUCTURE	*This could not be inspected since it is underwater and located below the control house floor.*	
OUTLET STRUCTURE AND POND DRAIN	*The 10 inch water supply pipe is buried and could not be inspected but the end of the 12 inch clay drain pipe was inspected and found to be in fair condition. Portions of the clay pipe were chipped or cracked but it should function.*	
OUTLET CHANNEL	*The pond drain and spillway channel are located as shown in Appendix E. They discharge down the junction of the embankment and abutment for a distance, then down the embankment to the toe and along the toe to the channel. The rock is porous and the water travels through and under the rock. During the exercising of the valve, the discharge water flowed a short distance down the channel before disappearing and was assumed to flow below the surface and into the foundation materials.*	
EMERGENCY GATE	*See above discussion on pond drain.*	

UNGATED SPILLWAY
(CONCRETE)

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	*This weir is in fair condition with some minor spalling and deterioration which is expected for this 60 year old structure. The concrete joints are in poor condition with signs of deterioration and spalling at the joint contacts.*	
APPROACH CHANNEL	*The concrete walls of the channel above the water line are in good condition.*	
DISCHARGE CHANNEL	*The water over the weir discharges directly into a rocky surface to the embankment toe. Since the rock is porous, the water penetrates the rock flowing through the foundation materials.*	
BRIDGE AND PIERS	*The wooden foot bridge over the 12 foot deep approach channel is in fair condition but does not have a hand railing and is considered a safety hazard. The bridge should be reconstructed to eliminate the safety hazard.*	

UNGATED SPILLWAY
(ROCK CHANNEL)

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	*None*	
APPROACH CHANNEL	*Natural shales are in good condition. The channel is poorly designed and is essentially just a swale through the embankment which can discharge water.*	
DISCHARGE CHANNEL	*Shales are in good condition but the discharge channel consists of the dam abutment contact zone. The discharge flows along the abutment contact through rock and into the valley. A very poor design.*	
BRIDGE AND PIERS	*None*	
GATES AND OPERATION EQUIPMENT	*None*	

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	*None*	
OBSERVATION WELLS	*None*	
WEIRS	*None*	
PIEZOMETERS	*None*	
OTHER	*None*	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	*Reservoir slopes are moderate. Cottages with lawns and some trees are along the lower end of the reservoir. The remaining portion of the slopes are covered with grass/brush.*	
SEDIMENTATION	*The amount of sedimentation is unknown, no effect on flood storage.*	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	*The channel appears to be in good condition with little or no debris.*	
SLOPES	*The valley gradient ranges from 0.03 below the dam to 0.07, 1250 feet below the dam.*	
APPROXIMATE NO. OF HOMES AND POPULATION	*About 500 feet below the dam is the first home subject to damage in the event of a failure. Other buildings, including a school, subject to damage are located on the flood plain of the West Branch of the Leckawaxen River, about 6000 feet downstream from the dam.*	

APPENDIX

C

CADJAW DAM

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: *Approximately 30% wooded, 18% reservoir surface area, rest open/residential.*

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): *1318* (921 Acre-Feet).*

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): *1321.25 top of spillway wall (1234 Acre-Feet).*

ELEVATION MAXIMUM DESIGN POOL: ---

ELEVATION TOP DAM: *1321.2* feet, the height of the spillway wall at the embankment centerline, considered the minimum elev. of the dam.*

EMERGENCY SPILLWAY

a. Elevation *1318.3* feet.*

b. Type *Trapezoidal channel.*

c. Width *Bottom, 11 feet; top, 32± feet.*

d. Length *85 ± feet.*

e. Location Spillover *Right abutment.*

f. Number and Type of Gates *None.*

OUTLET WORKS:

a. Type *Broad crested weir; Gate House.*

b. Location *Adjacent to Gate House; downstream of dam axis, right abutment.*

c. Entrance inverts *1318*; unknown*

d. Exit inverts ----; *unknown.*

e. Emergency draindown facilities *12 inch pipes.*

HYDROMETEOROLOGICAL GAGES:

a. Type *Standard rain gage.*

b. Location *No. One Pond 4.5 miles N-NE of Cadjaw Dam.*

c. Records *Honesdale Consolidated Water Company's office, Honesdale.*

MAXIMUM NON-DAMAGING DISCHARGE:

**Based on assuming the bottom of the spillway notch is at elevation 1318 feet, the reservoir surface elevation shown on the USGS map.*

DAM SAFETY ANALYSIS
HYDROLOGIC/HYDRAULIC DATA

Date: 11/15/78
By: MFB
Sheet: 2 of 10

DAM Cadjaw Dam Nat. ID No. PA00168 DER No. 64-10

ITEM/UNITS	Permit/Design Files (A)	Calc. from Files/Other (B)	Calc. from Observations (C)
1. Min. Crest Elev., ft.			
2. Freeboard, ft.			
3. Spillway[1] Crest Elev, ft.	2.5 ft below crest		
3a. Secondary[2] Crest Elev, ft.		4 ft. below crest	
4. Max. Pool Elev., ft.			1321.25
5. Max. Outflow[3], cfs	71	> 400	
6. Drainage Area, mi²	0.7		0.72
7. Max. Inflow[4], cfs			2064
8. Reservoir Surf. Area, Acre	89		85
9. Flood Storage[5], Ac-Ft			

Reference all figures by number or calculation on attached sheets:

Example: 3A - Drawing No. xxx by J. Doe, Engr., in State File No. yyyy.

NOTES:

(1) Main emergency spillway.

(2) Secondary ungated spillway.

(3) At maximum pool, with freeboard, ungated spillways only.

(4) For columns B, C, use PMF.

(5) Between lowest ungated spillway and maximum pool.

Date: 12/14/78
By: MEB
Sheet: 3 of 10

HYDROLOGIC/HYDRAULIC CALCULATIONS (cont.)

Item (from sheet 2)	Source
3A, 5A, 6A, 8A	"Report upon the Cadjaw Dam" dated August 3, 1917
3a, 8, 5B	"Report upon the Construction of a New Spillway ...", dated January 17, 1918
4C	Field Survey
7C	Sheet 10
6C, 8C	From USGS Map Honesdale, PA (1969)

HEC-1, REVISED
FLOOD HYDROGRAPH PACKAGE

The original "Flood Hydrograph Package" (HEC-1), developed by the Hydrologic Engineering Center, Corps of Engineers, has been modified for use under the National Dam Inspection Program. The "Flood Hydrograph Package (HEC-1), Dam Safety Version", hereinafter referred to as, HEC-1, Rev., has been modified to require less detailed input and to include a dam breach analysis. The required input is obtained from the field inspection of a dam, any available design/evaluation data, relatively simple hydraulic calculations, or information from the USGS Quandrangle maps. The input format is flexible in order to reflect any unique characteristics of an individual dam.

HEC-1, Rev. computes a reservoir inflow hydrograph based on individual watershed characteristics such as: area, percentage of impervious surface area, watershed shape, and hydrograph characteristics determined from regional correlation studies by the Corps of Engineers, Baltimore District. The inflow is routed through the reservoir using spillway discharge data obtained from the field inspection or design data. Flood storage capacity is determined from USGS maps or design information and verified by the field inspection. In the event a spillway cannot discharge 0.5 PMF without overtopping and failure of the dam, downstream channel characteristics obtained from the field inspection and USGS maps are inputed and flows are routed downstream to the damage center and a dam breach analysis is performed.

Included in this Appendix are the HEC-1, Rev. pertinent input values and a summary print-out tables.

Classification (Ref. Recommended Guidelines for Safety Inspection of Dams)

1. The hazard potential is rated as "High" as there would be loss of life if the dam failed.

2. The size classification is "intermediate" based on its 1229 Ac-Ft. total storage.

3. The spillway design flood, based on size and hazard classification, is the Probable Maximum Flood (PMF).

Hydrologic and Hydraulic Analysis

1. Design data. In 1917 the State directed that provision be made for a spillway discharge of not less than 400 cfs. A channel was cut through rock and soil.

2. Evaluation of present structure was by the use of the computer program. Computer input data as follows:

Inflow hydrograph
rainfall - ref. Hydrometerological Report No. 33
Snyder's hydrograph parameters, t_p & C_p
$t_p = C_t L^{0.6}$
(this equation for t_p used because of the large area and length of the reservoir with respect to the watershed),
$C_t = 1.23$ Information received from
$C_p = 0.45$ Corps of Engineers, Baltimore District
$L = 0.62$ miles (dist. from upper end of reservoir to W.S. divide)
$t_p = 0.92$

Reservoir routing
elevation - storage data, shown on sheet 9
volume below spillway elevation supplied by owner, volume above spillway elevation taken from USGS map

elevation - discharge data shown on sheet 9

Concrete broadcrested weir

$Q = C L H^{3/2}$

C = 2.66 (ref. King & Brater, Handbook of Hydraulics)

L = 2.58 ft length of notch

L = 7.08 ft total length of weir

When reservoir water elevation is 1320.08 ft, at the top of the spillway wall at the weir.

$Q = 2.66 \cdot 7.08 \cdot 1.67^{3/2} = 40$ cfs (neglecting spillway notch) ✓

When reservoir water elevation is 1321.25 ft, at the top of the spillway wall at dam axis,

$Q = 2.66 \cdot 7.08 \cdot 2.84^{3/2} = 90$ cfs ✓

Emergency Spillway (Trapezoidal Channel)

$Q = C L H^{3/2}$

C = 2.5 assumed

L @ 1/2 H

existing bottom width = 11 ft.
existing top width = 32 ft
existing depth = 3 ft.

Bottom elev. 1318.3 ft., 4 inches above notch in concrete weir

When reservoir water elevation is 1320.08 ft

$Q = 2.5 \cdot 12.23 \cdot 1.78^{3/2} = 102$ cfs ✓

When reservoir elevation is 1321.25 ft.

$Q = 2.5 \cdot 21.32 \cdot 2.95^{3/2} = 220$ cfs ✓

Overtopping potential - as shown on sheet 10, the spillways discharge 0.5 PMF but not 0.6 PMF; therefore, the spillways are rated as "Inadequate" but not "Seriously Inadequate".

MFB 12/14/78 Cadjaw Pond Dam Sht 7 of 10
Hydrology / Hydraulics

```
1**********
 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION      JULY 1978
   LAST MODIFICATION  21 AUG 78
 **********

 RUN  DATE= 78/12/14.
      TIME= 08.01.05.
```

CADJAW POND DAM
NAT ID NO. PA 00168 DER NO. 64-10
OVERTOPPING ANALYSIS

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
100	0	15	0	0	0	0	0	4	0
			JOPER	NUT	LROPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 5 LRTIO= 1

RTIOS= .50 .60 .70 .80 1.00

SUB-AREA RUNOFF COMPUTATION

RUNOFF COMPUTATION

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.72	0.00	.72	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	21.00	111.00	123.00	133.00	158.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	.18

UNIT HYDROGRAPH DATA

TP= .92 CP= .45 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 34 END-OF-PERIOD ORDINATES, LAG= .92 HOURS, CP= .45 VOL= 1.00

28.	103.	185.	221.	205.	173.	147.	124.	105.	89.
75.	63.	54.	45.	38.	32.	27.	23.	20.	17.
14.	12.	10.	9.	7.	6.	5.	4.	4.	3.
3.	2.	2.	2.						

0 END-OF-PERIOD FLOW

NO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	NO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	26.54	24.39	2.15	44852.
										(674.)	(620.)	(55.)	(1270.07)

HYDROGRAPH ROUTING

RESERVOIR ROUTING

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1318.	-1

STAGE	1318.0	1318.5	1319.0	1320.1	1321.3	1325.0
FLOW	0.	3.	23.	143.	360.	1236.
CAPACITY=	0.	430.	706.	921.	1104.	1313.	1548.
ELEVATION=	1307.	1311.	1315.	1318.	1320.	1322.	1324.

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
1318.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
1321.2	2.3	1.5	225.

PEAK OUTFLOW IS 352. AT TIME 43.50 HOURS

PEAK OUTFLOW IS 570. AT TIME 43.00 HOURS

PEAK OUTFLOW IS 778. AT TIME 42.75 HOURS

PEAK OUTFLOW IS 976. AT TIME 42.50 HOURS

PEAK OUTFLOW IS 1351. AT TIME 42.25 HOURS

MFB 12/4/78
Rev. 1/17/79

Cadjaw Pond Dam
Hydrology / Hydraulics

SH. 9 OF 10

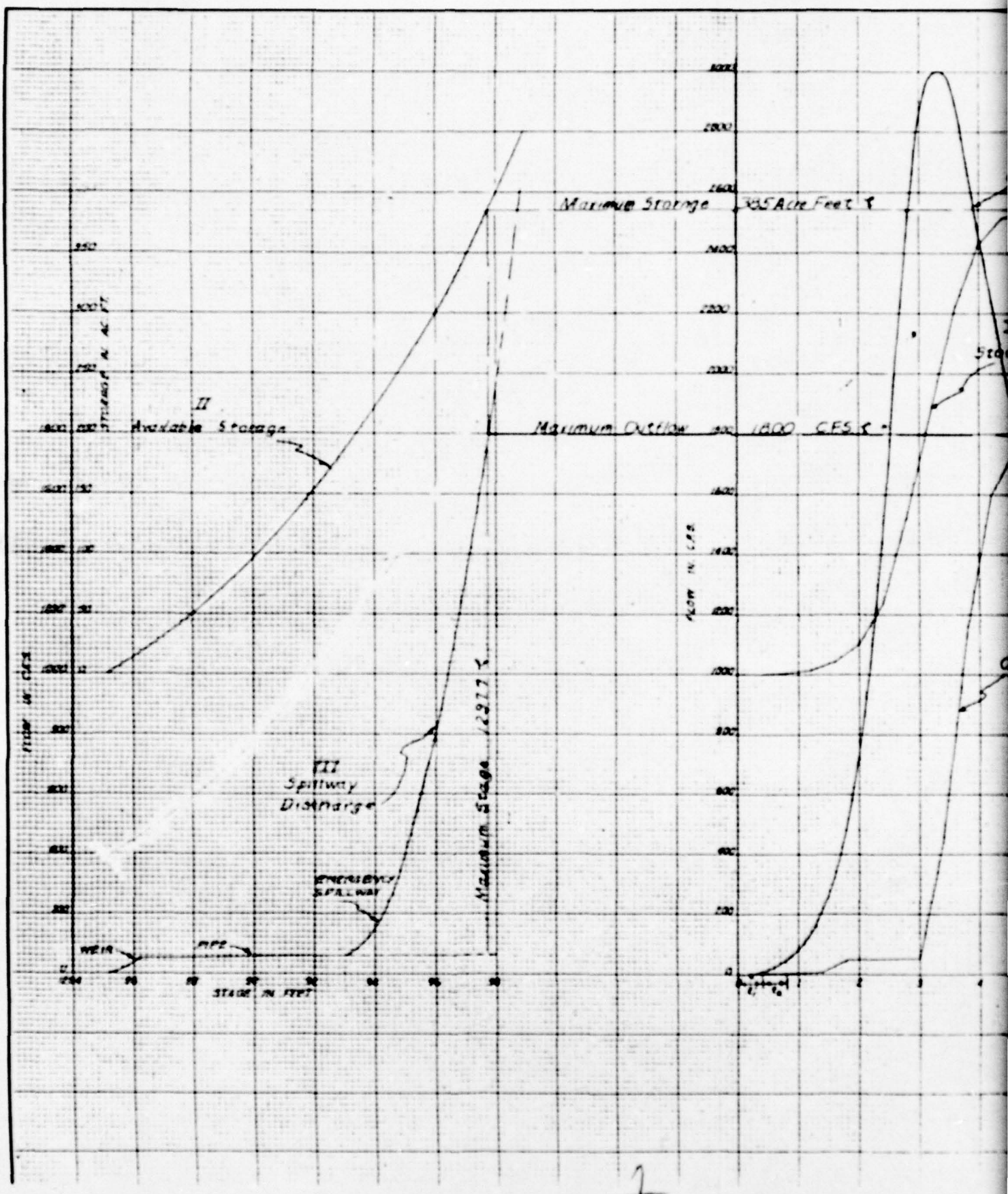
PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

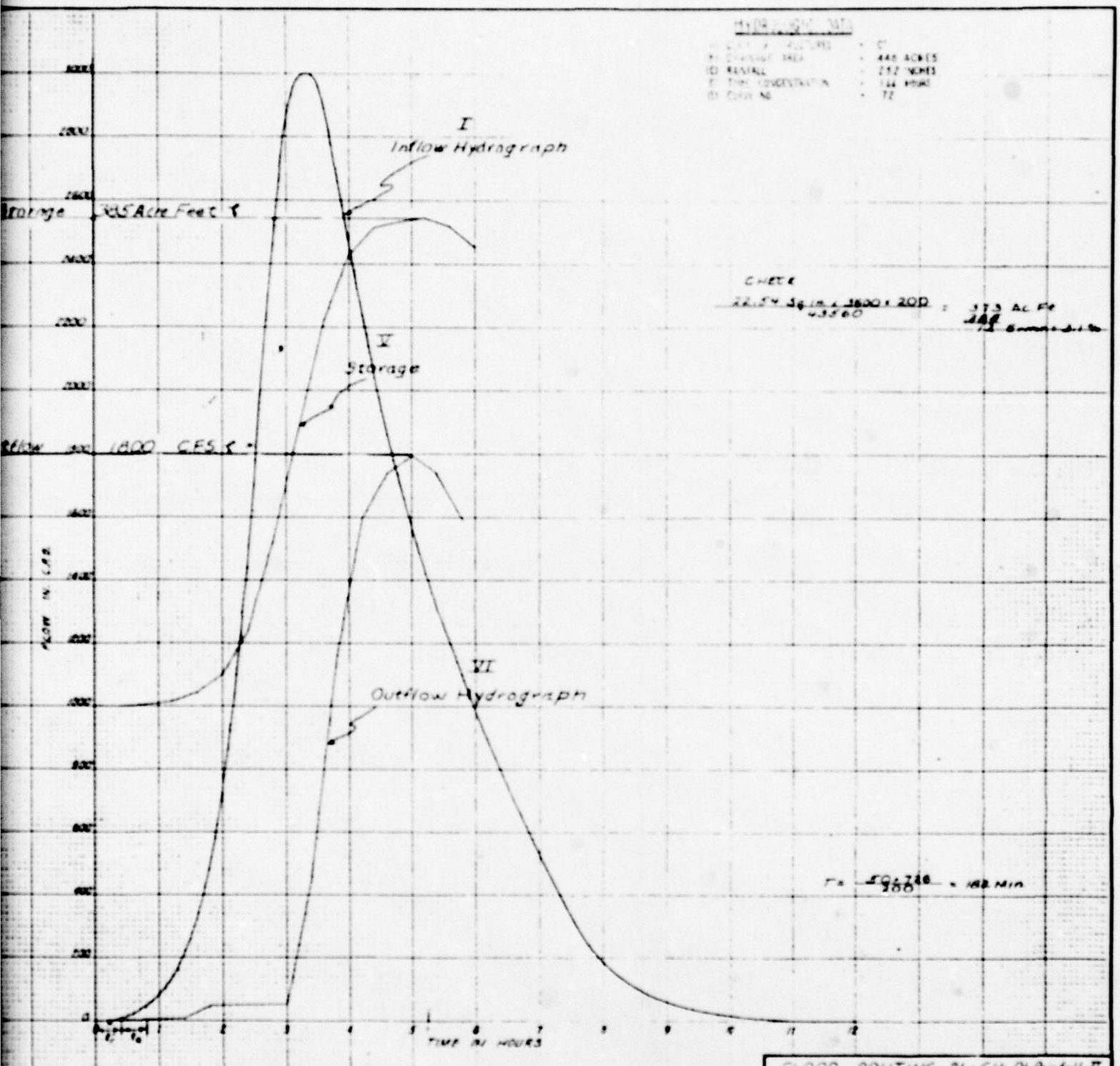
OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .50	RATIO 2 .60	RATIO 3 .70	RATIO 4 .80	RATIO 5 1.00
HYDROGRAPH AT	1	.72	1	1032.	1238.	1445.	1651.	2064.
	(	1.87)	(	29.22)(	35.06)(	40.90)(	46.75)(	58.43)(
ROUTED TO	2	.72	1	352.	570.	778.	976.	1351.
	(	1.87)	(	9.96)(	16.13)(	22.02)(	27.64)(	38.27)(

SUMMARY OF DAM SAFETY ANALYSIS

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1318.00	1318.00	1321.20
STORAGE	921.	921.	1229.
OUTFLOW	0.	0.	351.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	1321.20	.00	1230.	352.	.50	43.50	0.00
.60	1321.54	.34	1265.	570.	3.75	43.00	0.00
.70	1321.81	.61	1294.	778.	5.25	42.75	0.00
.80	1322.04	.84	1318.	976.	5.75	42.50	0.00
1.00	1322.41	1.21	1361.	1351.	7.00	42.25	0.00


I
Maximum Storage 985 Acre Feet
II
Available Storage
Maximum Outflow 1800 C.F.S.
III
Spillway Discharge
Maximum Stage 1287.7
WEIR
PIPE
STAGE IN FEET



CHECK

$\frac{22.54 \times 6 \text{ in} \times 3600 \times 20D}{43560} = 373 \text{ Ac Ft}$

$T_c = \frac{EQ \times 246}{300} = 148 \text{ Min}$

FLOOD ROUTING- 24-6 Hr PA Rainfall-II

LACKAWAXEN TRIB WATERSHED
PROTECTION PROJECT SITE PA-418
WAYNE COUNTY, PA

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SHEET 10A OF 10

APPENDIX

D

OVERVIEW OF PRINCIPAL AND EMERGENCY
SPILLWAY LOOKING DOWNSTREAM.

PHOTOGRAPH NO. 1

VIEW OF PRINCIPAL SPILLWAY CREST
AND CONTROL HOUSE INTAKE ON RIGHT
SIDE OF SPILLWAY CHANNEL.

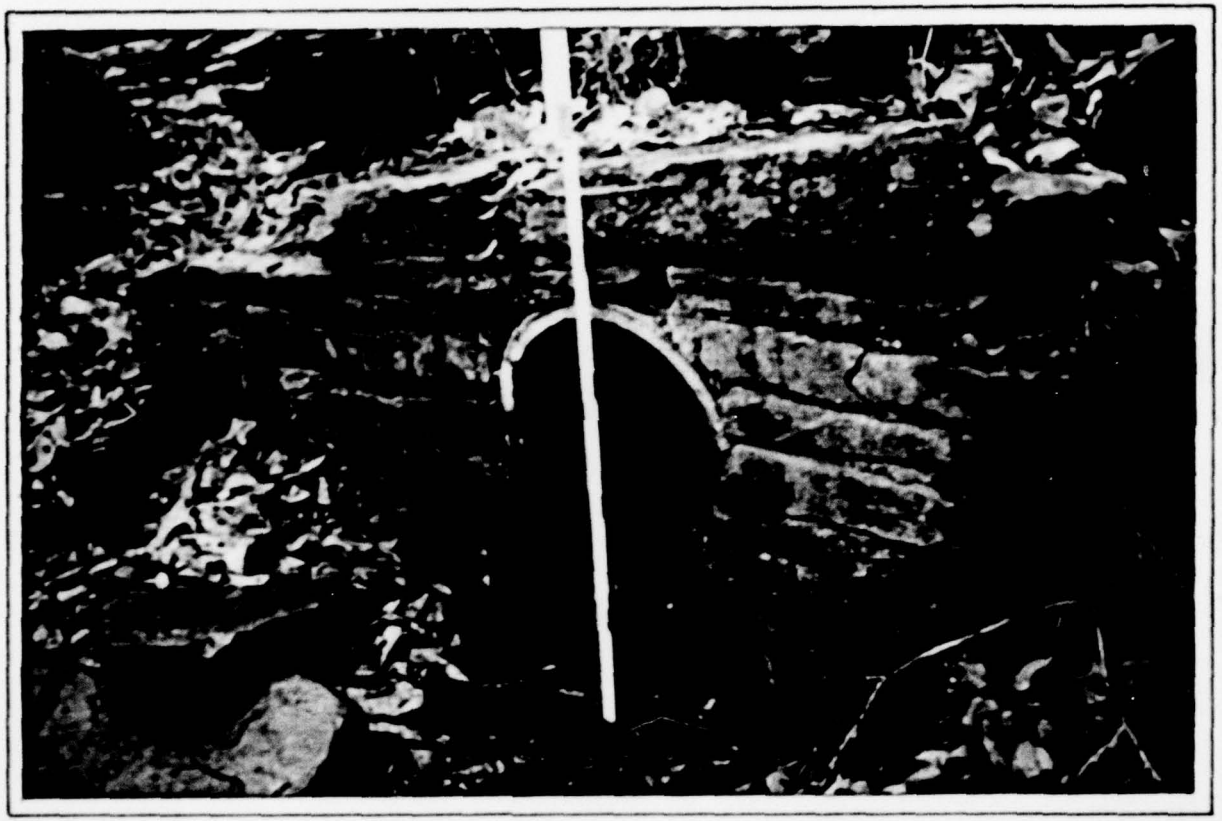
PHOTOGRAPH NO. 2

VIEW LOOKING UPSTREAM TOWARDS CONTROL HOUSE. NOTE POND DRAIN PIPE OUTLET IN LOWER LEFT AND PRINCIPAL SPILLWAY DISCHARGE CHANNEL.

PHOTOGRAPH NO. 3

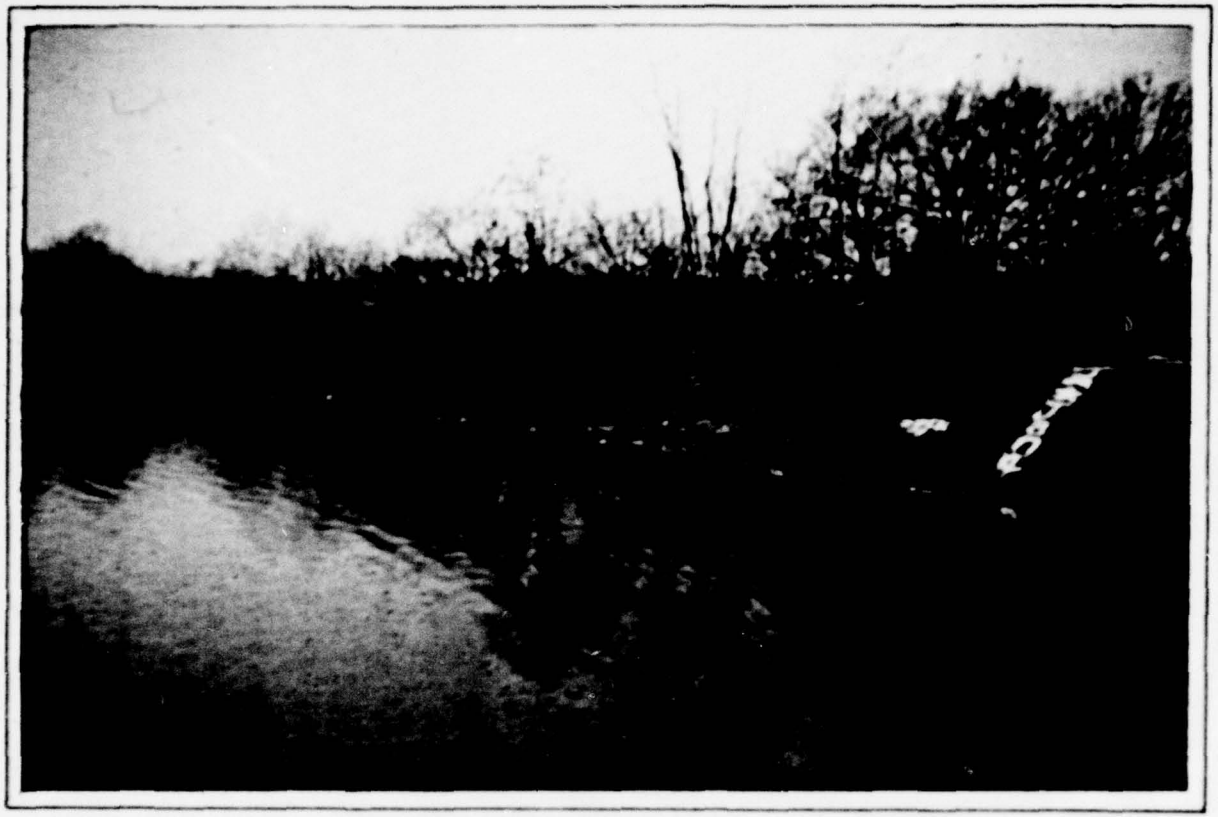
INSIDE CONTROL HOUSE. VALVES CONTROL WATER SUPPLY AND POND DRAIN PIPES.

PHOTOGRAPH NO. 4



VIEW OF POND DRAIN DISCHARGE PIPE.

PHOTOGRAPH NO. 5



OVERVIEW OF UPSTREAM SLOPE LOOKING
TOWARDS LEFT ABUTMENT.

PHOTOGRAPH NO. 6

VIEW OF DAM CREST LOOKING TOWARDS
RIGHT ABUTMENT.

PHOTOGRAPH NO. 7

OVERVIEW OF DOWNSTREAM SLOPE.
NOTE MARSHY AREA AT BASE OF
DAM.

PHOTOGRAPH NO. 8

CLOSE UP OF MARSHY AREA
BEYOND TOE AND SEEPAGE
CHANNELS.

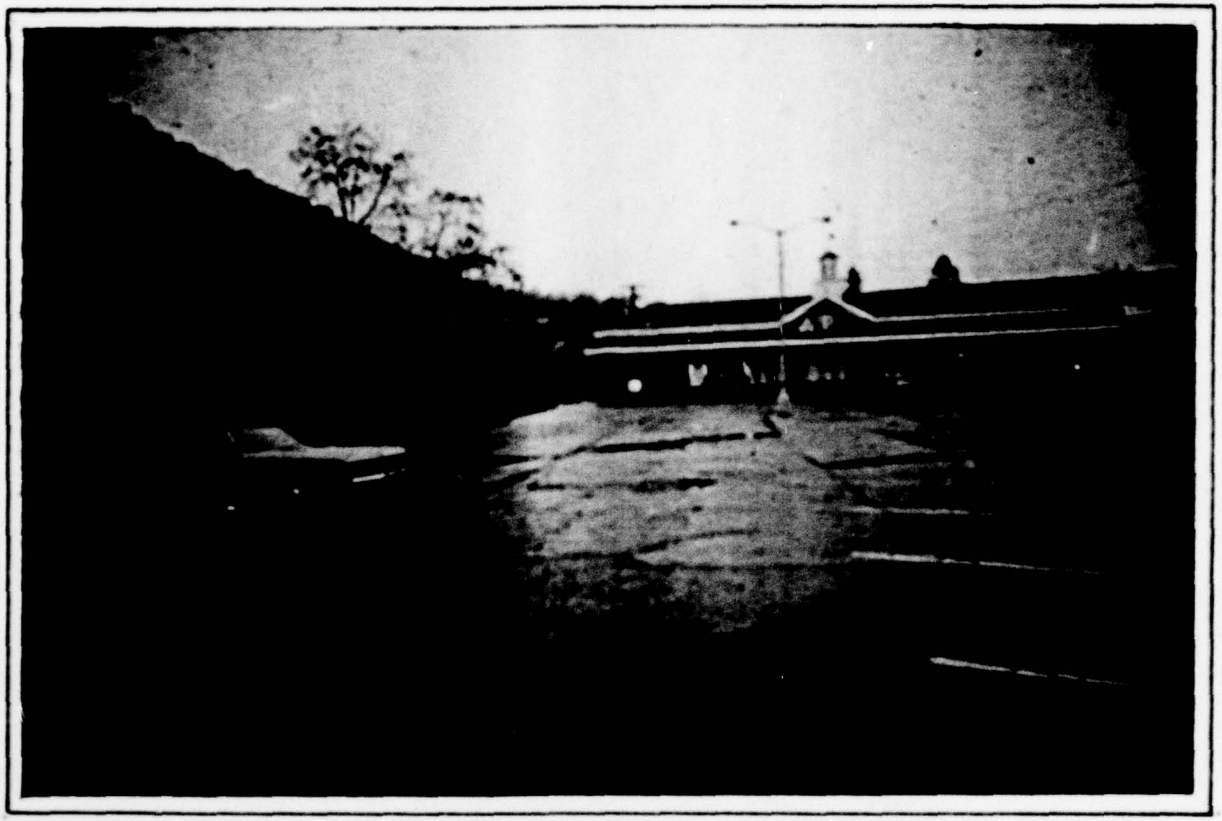
PHOTOGRAPH NO. 9

SPALLED CONCRETE OF
PRINCIPAL SPILLWAY
CHANNEL WALLS.

PHOTOGRAPH NO. 10

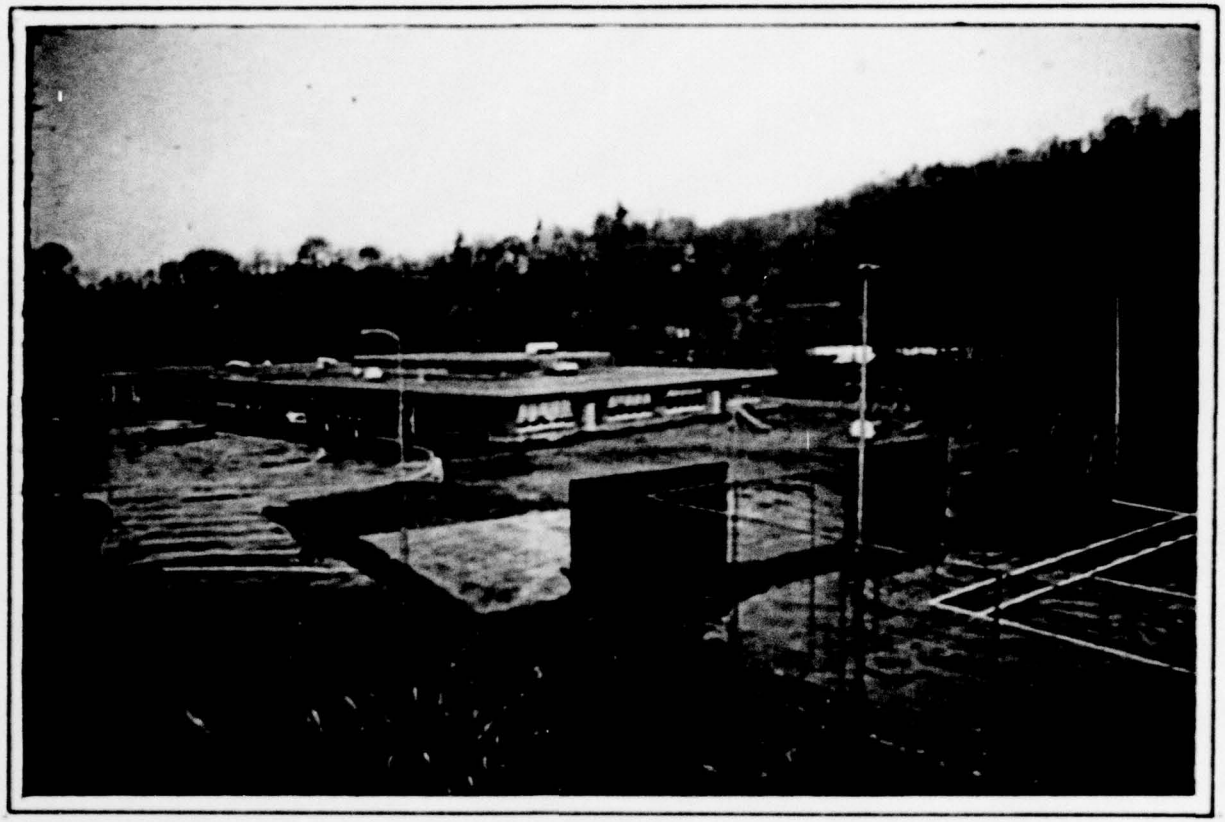
DISCHARGE CHANNEL THROUGH FARM
JUST BELOW THE DAM.

PHOTOGRAPH NO. 11



FLOWS DISCHARGE INTO LACKAWAXEN
RIVER ON THE LEFT BEHIND THE
A & P STORE.

PHOTOGRAPH NO. 12

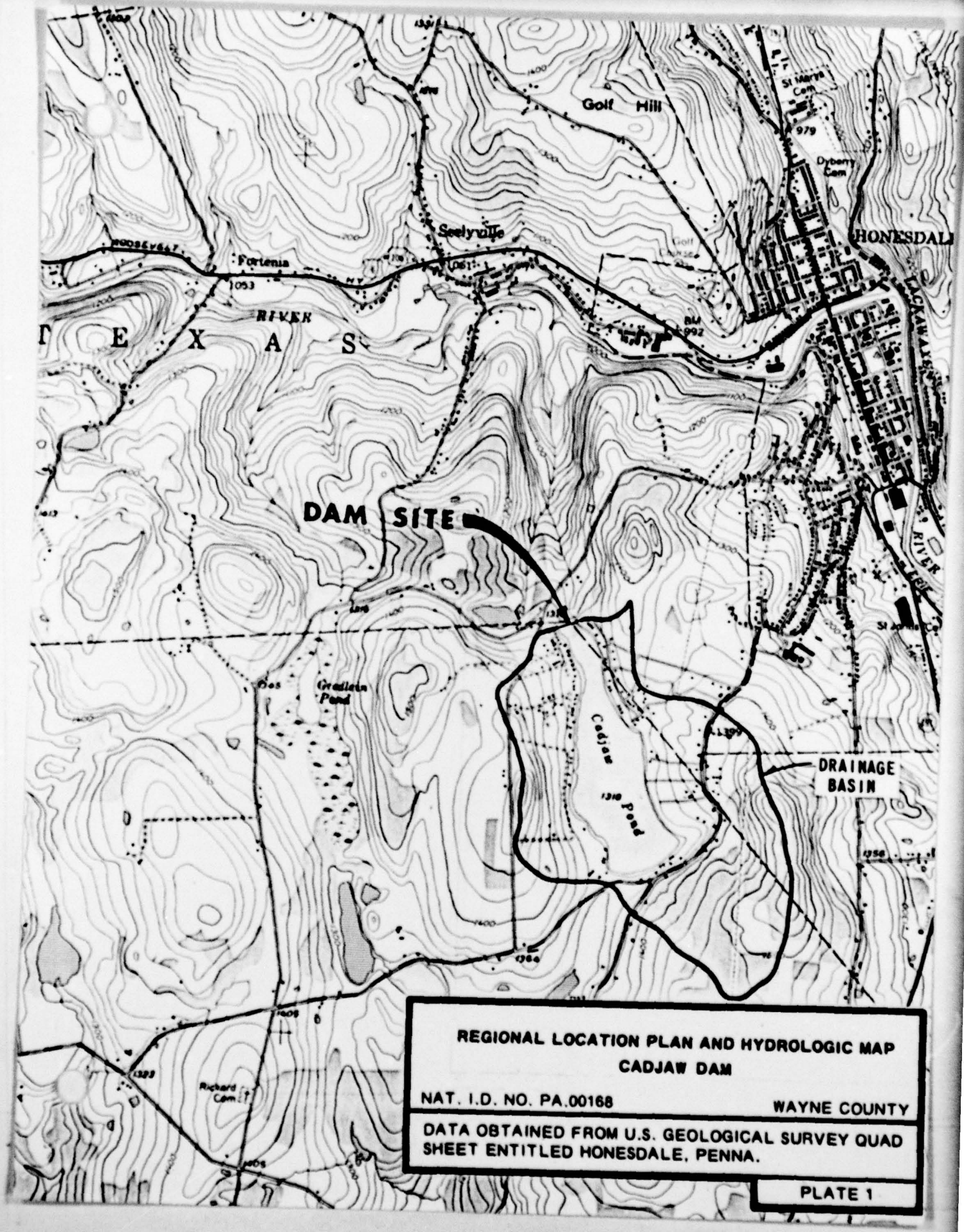


SCHOOL LOCATED ON FLOOD PLAIN ALONG
LACKAWAXEN RIVER.

PHOTOGRAPH NO. 13

APPENDIX

E

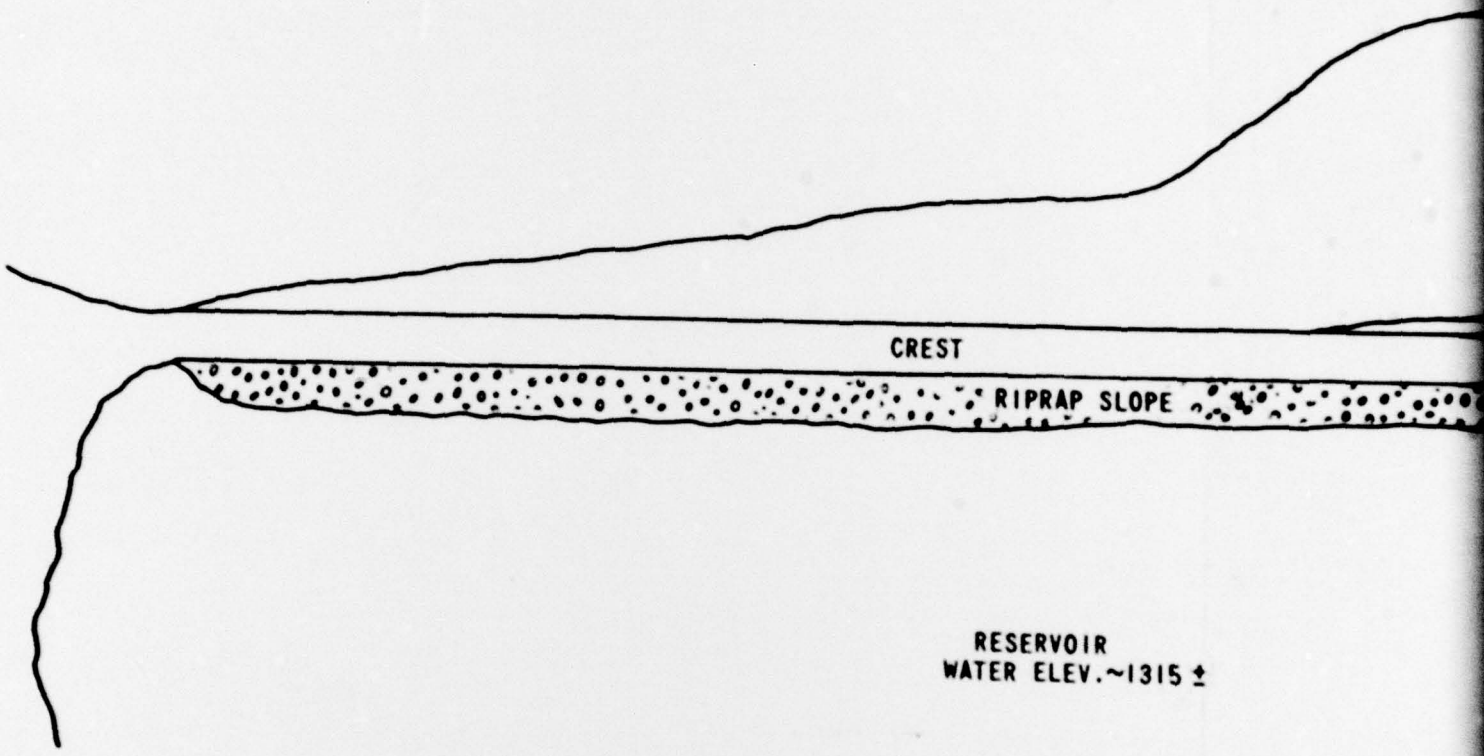


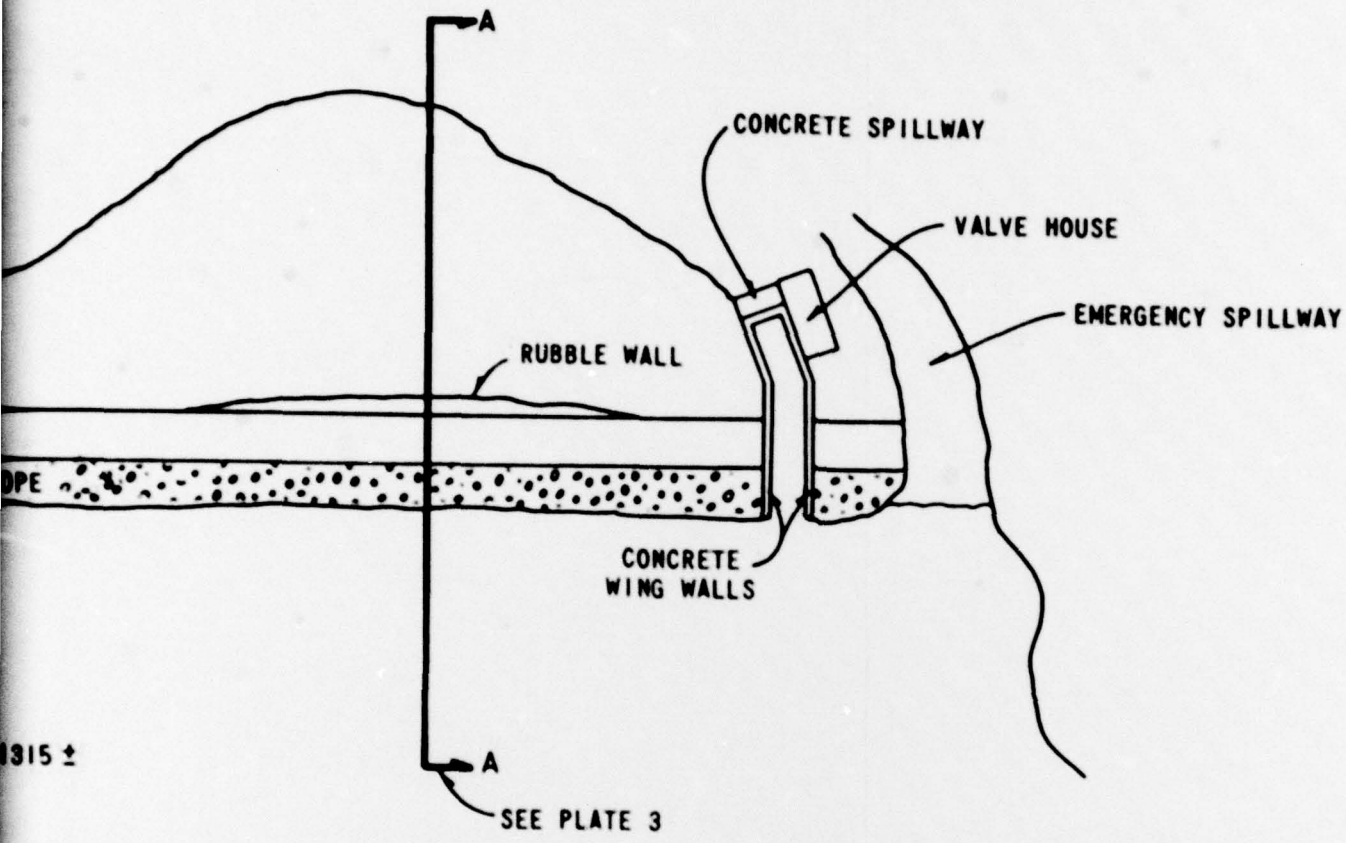
REGIONAL LOCATION PLAN AND HYDROLOGIC MAP
CADJAW DAM

NAT. I.D. NO. PA.00168 WAYNE COUNTY

DATA OBTAINED FROM U.S. GEOLOGICAL SURVEY QUAD SHEET ENTITLED HONESDALE, PENNA.

PLATE 1


CREST
RIPRAP SLOPE
RESERVOIR
WATER ELEV.~1315 ±



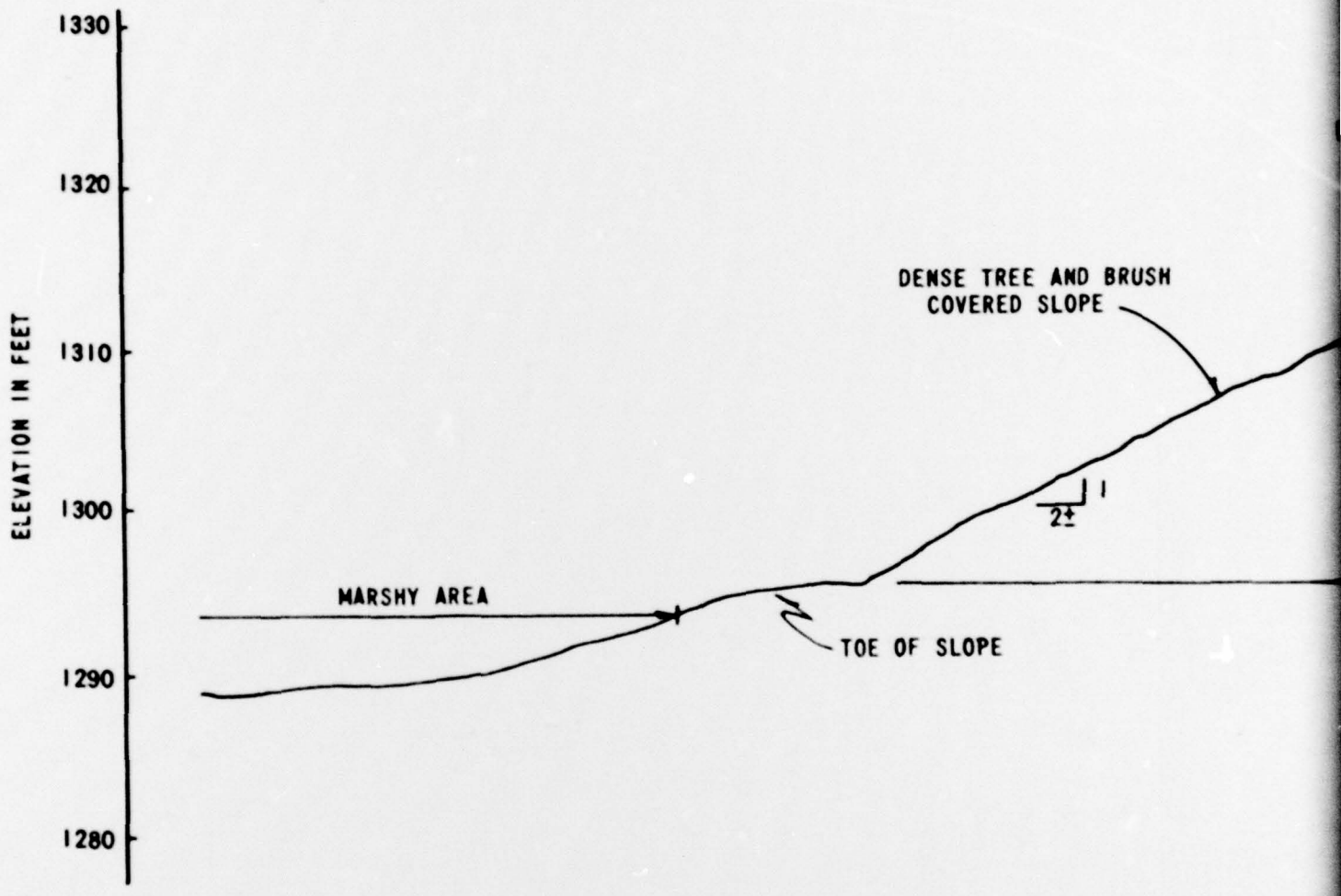
PLAN OF DAM AND APPURTENANCES
CADJAW DAM

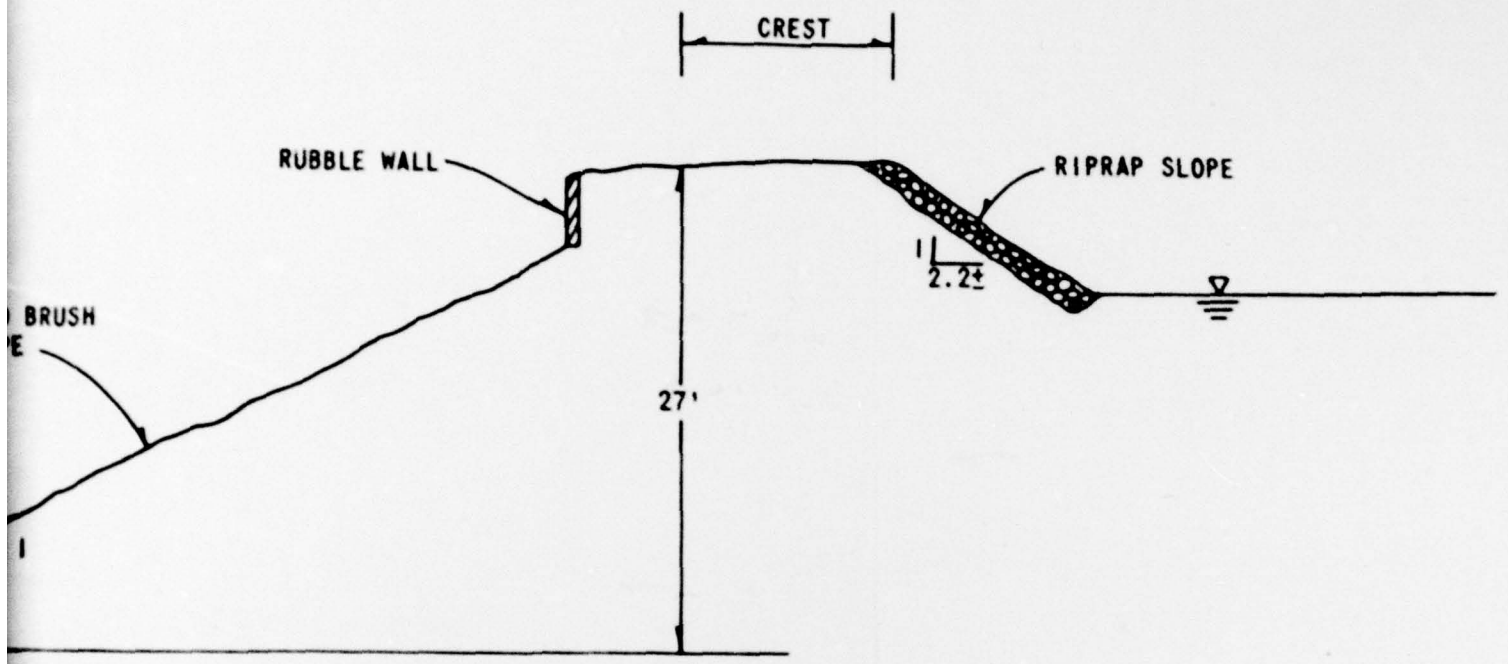
NAT. I.D. NO. PA.00168 — WAYNE COUNTY

ALL DATA OBTAINED FROM FIELD MEASUREMENTS
TAKEN DURING INSPECTION

PLATE 2

1 2


1330
1320
1310
1300
1290
1280
ELEVATION IN FEET
DENSE TREE AND BRUSH
COVERED SLOPE
2±
1
MARSHY AREA
TOE OF SLOPE



SCALE IN FEET

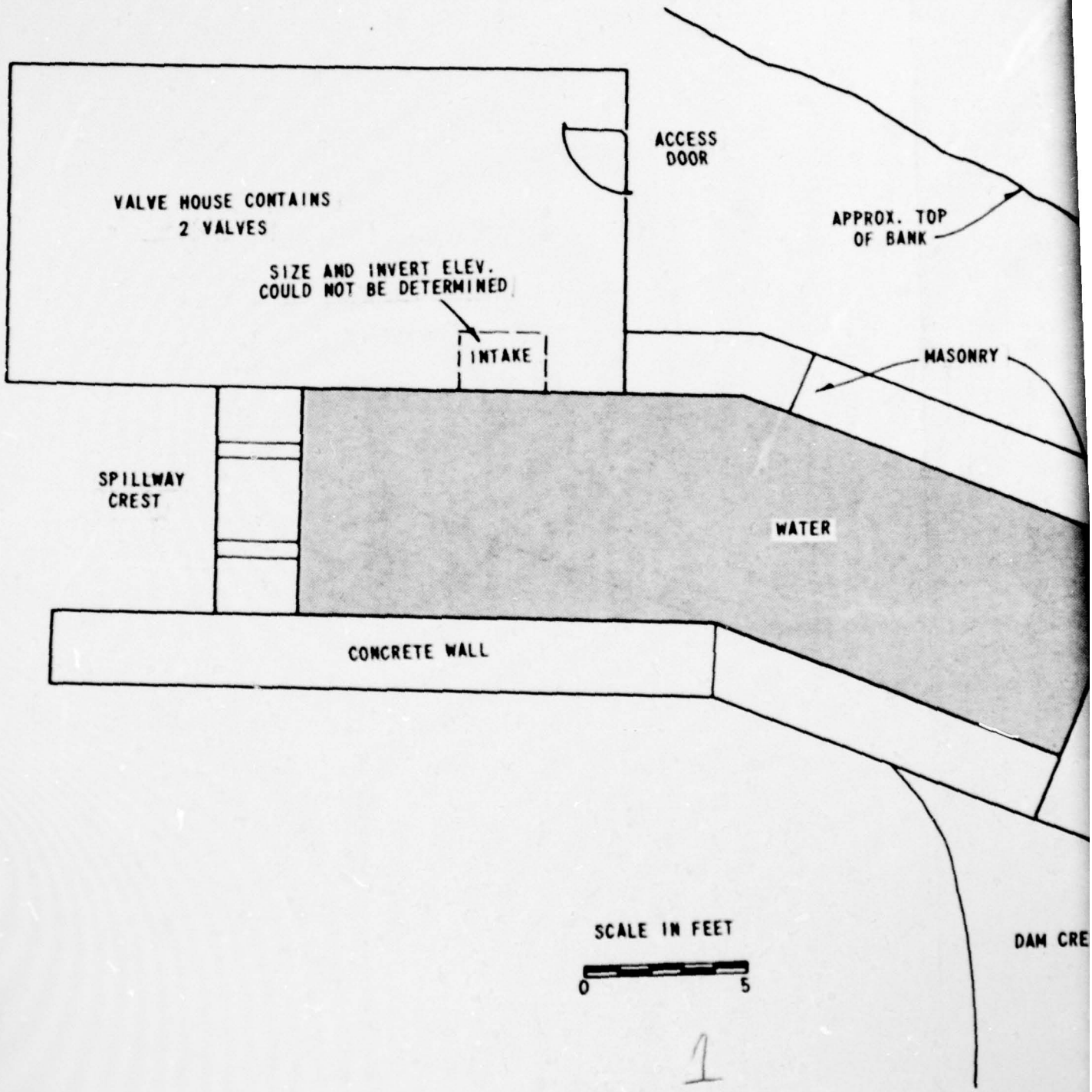
10 8 6 4 2 0 5 10

EMBANKMENT SECTION A-A
CADJAW DAM

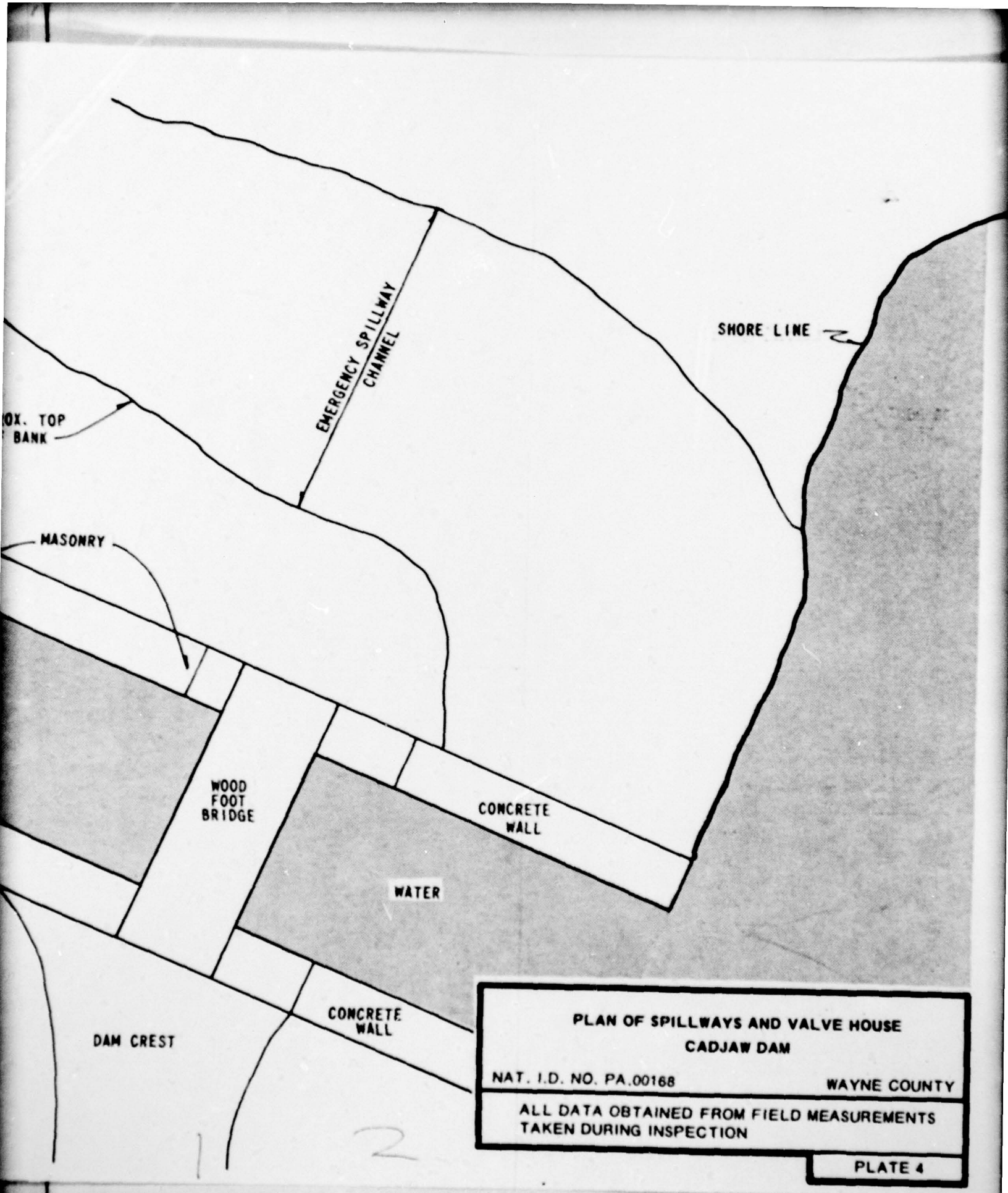
NAT. I.D. NO.PA.00168 WAYNE COUNTY

ALL DATA OBTAINED FROM FIELD MEASUREMENTS TAKEN DURING INSPECTION

PLATE 3


ACCESS
DOOR
VALVE HOUSE CONTAINS
2 VALVES
APPROX. TOP
OF BANK
SIZE AND INVERT ELEV.
COULD NOT BE DETERMINED
INTAKE
MASONRY
SPILLWAY
CREST
WATER
CONCRETE WALL
SCALE IN FEET
0
5
DAM CRE

1

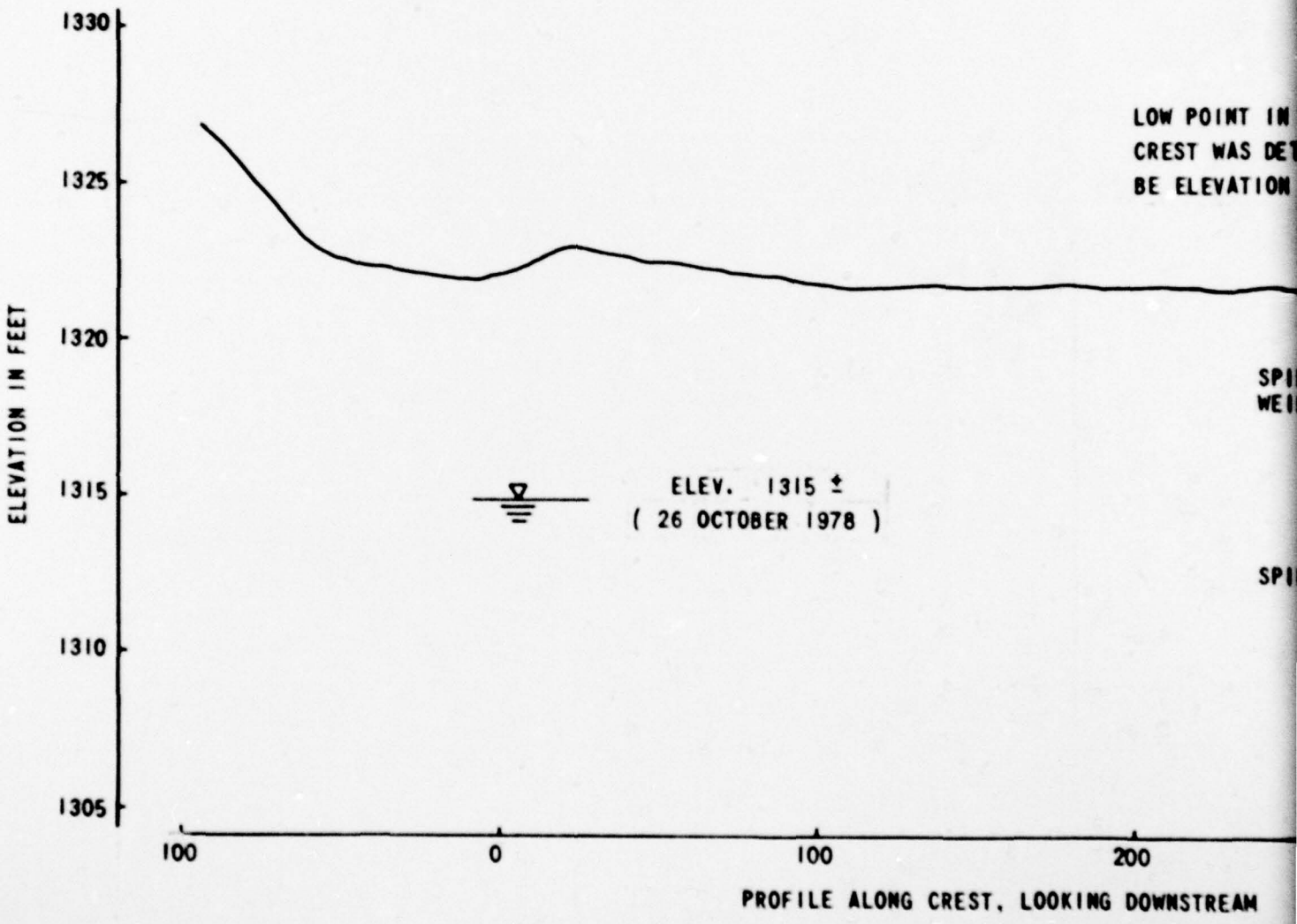


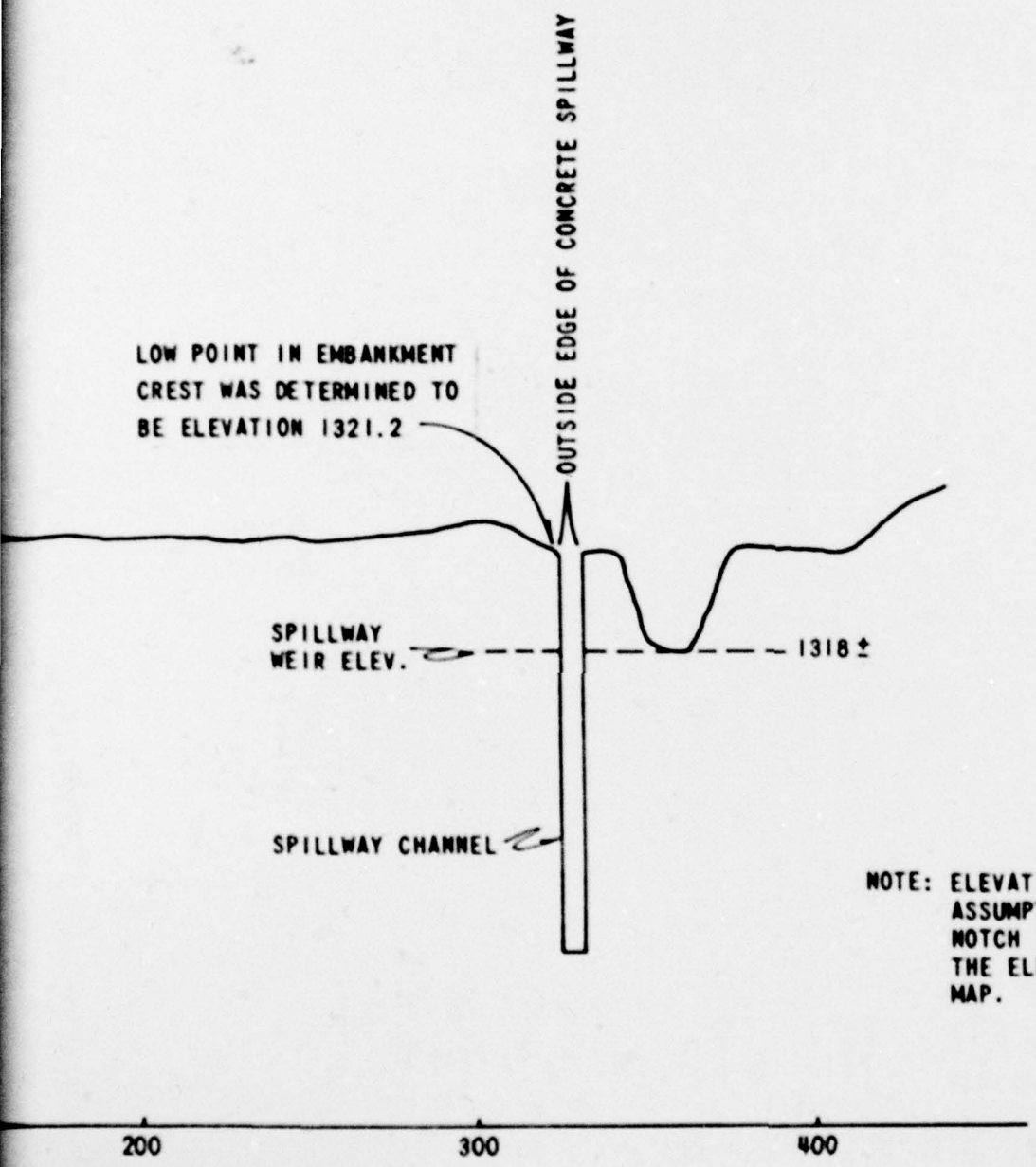
PLAN OF SPILLWAYS AND VALVE HOUSE
CADJAW DAM

NAT. I.D. NO. PA.00168 WAYNE COUNTY

ALL DATA OBTAINED FROM FIELD MEASUREMENTS
TAKEN DURING INSPECTION

PLATE 4


1330
1325
1320
1315
1310
1305
ELEVATION IN FEET
LOW POINT IN
CREST WAS DET
BE ELEVATION
SPI
WEI
ELEV. 1315 ±
(26 OCTOBER 1978)
SPI
100
0
100
200
PROFILE ALONG CREST, LOOKING DOWNSTREAM



NOTE: ELEVATIONS ARE BASED ON THE ASSUMPTION THAT THE SPILLWAY NOTCH IS AT ELEVATION 1318, THE ELEVATION ON THE USGS MAP.

PROFILE ALONG CREST LOOKING DOWNSTREAM
CADJAW DAM

NAT. I.D. NO. PA.00168 WAYNE COUNTY

ALL DATA OBTAINED FROM FIELD MEASUREMENTS TAKEN DURING INSPECTION

PLATE 5

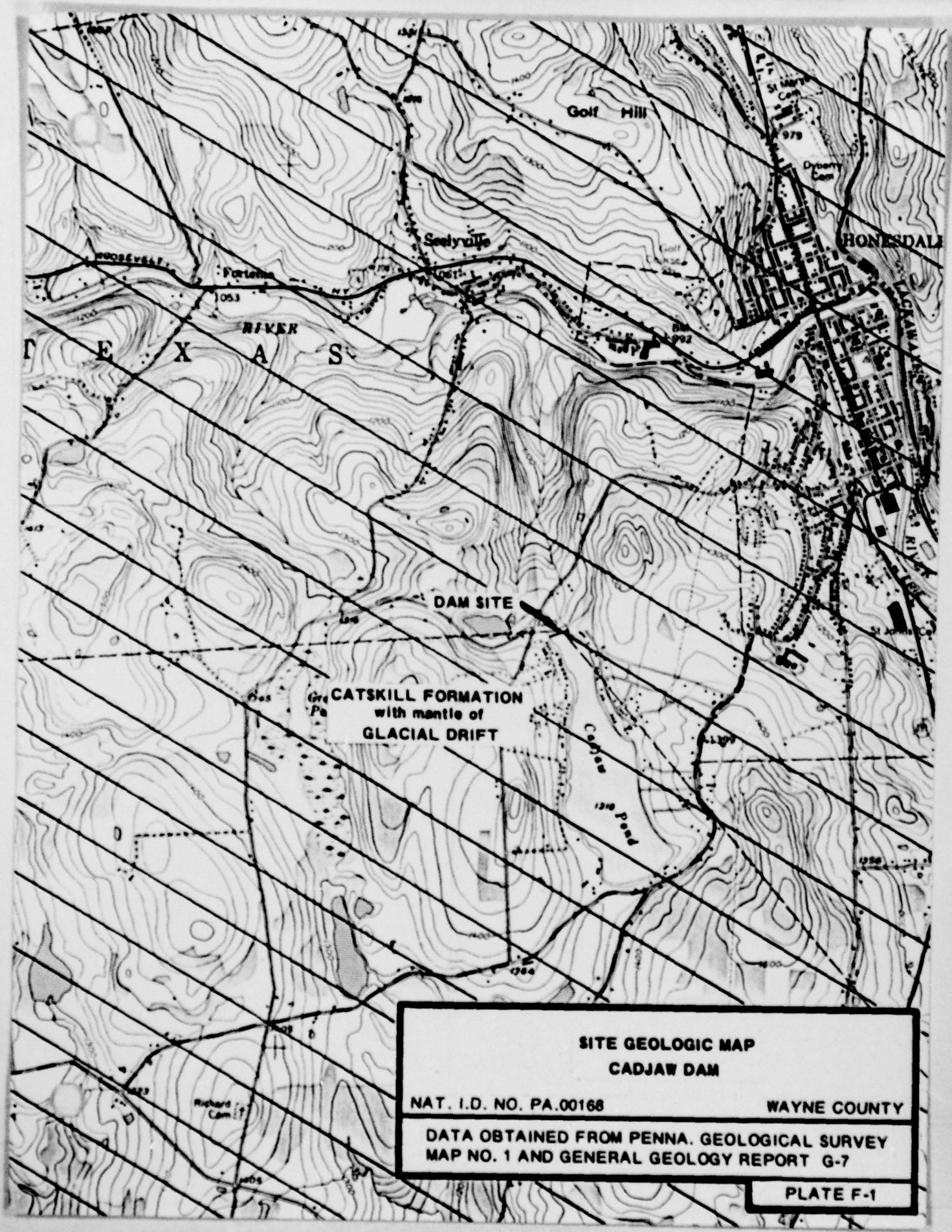
1 2

APPENDIX

F

SITE GEOLOGY
CADJAW DAM

Cadjaw Dam is located in the Glaciated Low Plateaus Section of the Appalachian Plateaus Physiographic Province. As shown in Plate F-1, the dam site and surrounding region, as is much of northeastern Pennsylvania, is underlain by the Upper Devonian age Catskill Formation which in turn is overlain by a mantle of Wisconsin age glacial drift. Much, if not all, of the dam is founded on bedrock as indicated by the rock exposures at the right abutment, spillway and gate house areas, in addition to the overall steepness of the downstream valley. The rock exposures consist of a red-brown, silty, fine sandstone having bedding striking to the north-northwest (near perpendicular to the dam axis) and dipping 6° to the west (toward the left abutment). Jointing is well developed with the predominant joint set striking near north-south (perpendicular to the dam axis) and dipping near vertical to the west. A lesser joint set strikes near east-west (parallel to the dam axis) and dips nearly vertical to the south (upstream). Joints are spaced commonly from 6 to 24 inches. Conditions favorable for seepage include the orientation of rock bedding planes and the major joint set, in addition to the interface with the old stream channel upon which the dam is constructed.



SITE GEOLOGIC MAP
CADJAW DAM

NAT. I.D. NO. PA.00168 WAYNE COUNTY

DATA OBTAINED FROM PENNA. GEOLOGICAL SURVEY
MAP NO. 1 AND GENERAL GEOLOGY REPORT G-7

PLATE F-1